AGRICULTURAL ENGINEERING

Established 1920

This journal is owned, edited, and published monthly by the American Society of Agricultural Engineers.

Editorial and advertising departments at the executive office of the Society, Saint Joseph, Michigan. Publication office at Benton Harbor, Michigan.

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Chicago: DWIGHT H. EARLY
100 North LaSalle St.
Telephone: CENtral 2184

New York: A. M. WILLCOX
420 Lexington Ave.
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SUBSCRIPTION PRICE: To non-members of the A.S.A.E., $3.00 a year in the U. S. and possessions and in Americo-Spanish countries, $3.50 a year in Canada, and $4.00 a year in all other countries; to A.S.A.E. members anywhere $2.00 a year. Single copies (current) 30 cents each.

POST OFFICE ENTRY: Entered as second-class matter, October 28, 1933, at the post office at Benton Harbor, Michigan, under the Act of August 24, 1912. Additional entry at St. Joseph, Michigan. Acceptance for mailing at the special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized August 11, 1921.

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EDITORIAL

Born without Feet

IF there are to be no more rubber tires for farm tractors after May first, as indicated by press reports, there will be a lot of farm tractors born without feet, unless there is quick provision for makeshift steel rims and lugs. Let us hope that before these words reach the reader, there will be a swift slashing of red tape to grant the necessary permission and release the necessary steel. Only thus can the pitifully small production of new farm power play its part in the growing and harvesting of 1942 crops.

Emphasis should be put on the word "makeshift." It would be making progress backward to revert to the old-fashioned steel wheels. Every effort should be made to salvage all the rubber-tire wheel centers now on hand or in process, simply supplementing them with temporary steel rims for the duration of the rubber shortage. It should save the nation's steel now, and the farmer's money later when he finally gets the rubber tires he wants.

Probably the use of steel rims and lugs on wheels designed for rubber will cause excessive shock stresses and invite breakage in greater number than normal. Within reason, such failures can be considered the casualties of war. To hold breakage within reason is the two-fold job of the agricultural engineer. Within the limits of development time and materials available, the design engineer may minimize the excess stresses, or perhaps divert them to readily replaceable members.

Engineers in the educational wing of the profession will have the job of teaching farmers to "baby" the makeshift wheels, to keep both shock and fatigue forces inside of bounds. This will be particularly important for tractors never intended to run on steel, and in which axles, bearings, frame, and transmission system all may meet stresses for which they were not designed. In a word, they must teach that these *are* makeshift wheels.

Disinterest, a Delusion

ONE reason why war costs too much is the naive notion that the problems of war production must be entrusted to men who know nothing of actual production, or at best men whose knowledge is detached, academic. This is not an absolute rule. There are enough exceptions to prove our point, namely, that the way to lick a big, tough job is to drop it in the lap of a man with a record of having licked similar big, tough jobs.

At least in the realms of manufacture and transportation, such men are to be found only in the topmost ranks of big business. Against this self-evident fact is set up the supposition that a man who has risen to high responsibility and acquired some proprietary interest in an industry, cannot be honest in momentous public affairs which involve that industry. No class has a monopoly of honesty and ethics, surely not the classes who make a business of blackguarding business. But ordinary observation reveals that the percentage of integrity runs higher as the level of responsibility and achievement mounts higher.

Disinterest as the dominant criterion in the choice of public administrators leads nowhere but to mediocrity, muddling, waste, and delay. Until we stop bowing to the idol of disinterest, we shall continue to exclude every man able to take hold of a job and do it supremely well. Until we rely on the record of men for experience and integrity, we shall not fully mobilize this nation for war.

All this is obvious to us as engineers. Our failure is in thinking that it is obvious to everybody. Simple as it seems, it is a story largely untold. Engineers are in a good position to tell it. Let it be a part of that public leadership which Arthur Huntington, a past-president of A.S.A.E., preached as the duty of the engineer.—W.B.J.

The Old Order Changeth

WE are in a war we must win. Without costly soil abuse or waste, agriculture must contribute the greatest production in history. All facilitating tools must be utilized. No promising methods can be left untried.

Mulch farming is such a method. It is the production of crops in imitation of Nature's way. Nature turns no plant residues under; they fall to the ground and produce a surface mulch through which succeeding crops emerge. Our reserves of soil and plant food were progressively developed under protective surface mantles of vegetation and decaying litter. Nature's method may well be imitated more closely for efficient production of agricultural crops.

Mulch farming promises increased yields and lower production costs without waste of soil. It protects soil against damage by wind and water, and it conserves moisture for crop production by increasing infiltration and retarding evaporation. These potentialities have spotlighted this revolutionary practice, and it has already been tagged with various labels. Many call it "subsurface tillage"; others "stubble mulch" or "vegetative mulch". "Trashy tillage", "plowless fallow" or "trashy fallow", and "stubbling-in" are older terms often used.

For generations clean tillage has been in vogue. Tradition and teaching led farmers to believe that good plowing, good coverage of crop residues, and good farming were synonymous. Most of our tillage and planting equipment has been designed for this mode of culture, and the toll of erosion under this system of farming has been enormous.

The introduction of disk tillers about 1927 marked the beginning of a period during which a form of semi-covering tillage has been used extensively. Disk equipment, which partially mixes crop residue with the surface soil, replaced many plows for initial tillage, particularly in the West. Speed of travel, size, curvature and angle of disks, and number of operations largely regulated the degree of coverage obtained. Unfortunately excessive coverage and soil pulverization is too easily attained.

Previous attempts to apply the principles of mulch farming have been localized and only partially successful because of inadequate information and equipment. To make more effective use of crop residues we must have equipment that tills the soil with little or no coverage of residue and determine its proper application. The new tillers of the V or straight-blade type, moldboardless plows, listers, rod weeders, or cultivators with shovel and sweep adaptations, are such noncovering implements. Developing and safely introducing this initial tillage and weeding equipment and the complementary planting machinery needed to seed grasses, legumes, and grains through various mulches is an essential step in tooling for this new form of tillage.

Determining the extent to which mulch farming can be successfully implemented into local cropping programs is a challenge to farmers and conservation technicians.

C. L. HAMILTON

AGRICULTURAL ENGINEERING

VOL. 23 APRIL 1942 NO. 4

Engineering in Wartime Agriculture

By Arnold P. Yerkes

MEMBER A.S.A.E.

WE are now at a most critical time in our nation's history. Our country is engaged in *total war*, quite different from any which we have heretofore fought. Destruction, both of lives and of property, in this war, has been on a scale never before known. If the value of property destroyed is ever totaled, it will probably be found greater than that in all previous wars put together. With many millions of the ablest men, the world over, devoting their utmost efforts to destruction, it is easy to see why production to the *n*th degree is required of every American citizen not in the armed services.

It has been stated times without number that "Production will win the war." That statement is axiomatic. No one will question for a moment the urgent need of the utmost production of planes, tanks, ships, guns, and munitions. Our army, navy, and air force need those things in abundance to insure greater destruction of the enemy's manpower and equipment than he is able to wreck upon us. They need them to reduce loss of life among our fighting forces, and of civilian lives and property. After General MacArthur's statement that "No general can make something out of nothing," and that his success depends upon the materials we supply him, anything short of maximum production is unthinkable and certainly will not be tolerated by the American public.

Consequently our war leaders are taking every possible step to insure maximum production of the sinews of war. The skilled workers turning out airplanes, tanks, guns, etc., are recognized as being just as important to our war effort as the men who will use them on the battle line.

Our enemies are just as aware of their need for maximum production as we are of ours. Unfortunately they have far more workers available than we have. That means that our workers, man for man, and woman for woman, must produce more than the workers in our enemies' factories. The only way they can do this is with superior equipment. We believe we have such equipment, but the safety margin is not great enough to warrant any complacency on this score. We shall need every available worker in our war industries as quickly as such workers can be trained and plant organizations developed to utilize them.

As a professional organization, the agricultural engineers are not directly concerned with the production of war material. You do have, however, a direct responsibility in attaining the utmost production of vitally essential foods, fibers, and vegetable oils. You all realize the truth of the slogan *"Food Will Win the War and Write the Peace"*, and you also realize fully where the agricultural engineer fits into the program for maximum agricultural production. It would be a waste of time to discuss this point at any length before a group of agricultural engineers, since every member of the profession is not only fully aware of his responsibilities in this respect, but he may also be counted upon to do his full part in accomplishing the desired results.

It may be worth while, however, to submit for your consideration a proposition which, so far as known, has not been carefully studied up to this time, and which appears to offer some worth-while help to the nation in its war efforts. This is the possibility of developing a program of transferring inefficiently employed farm workers to jobs in war industries or other agricultural sections where they can render more effective service. Offhand, it would seem probable that this could be done on a considerable scale without reducing agricultural production appreciably, if at all.

You are all familiar with the studies of Dr. J. B. Davidson of Iowa State College and others on the amount of labor required to produce a unit of various crops. The variation was almost unbelievably great. We know, therefore, that there are many very inefficient farm workers engaged in producing all of our staple crops. The problem is to evolve a workable plan for transferring as many as possible of these inefficient workers to jobs where their productive power is greater, yet without reducing agricultural production.

No attempt will be made to suggest the details of such a plan. This is something which might be worked out for each section of the country by the agricultural engineers of that section, preferably working as a group, and perhaps in cooperation with

An address delivered April 3, 1942, at a meeting of the Southwest Section of the American Society of Agricultural Engineers at Shreveport, La. Author: In charge, farm practice research, International Harvester Company.

other interested groups. There are two reasons why it would probably be better if such a plan is developed by group effort rather than by individual. First, the plan is likely to be sounder and more practicable if it is devised by the combined judgment of a number of men rather than by only one, and, second, a plan developed and sponsored by a group carries proportionately more weight than one developed and sponsored by an individual. For this program to accomplish real results, it should be put in such form and in sufficient detail that it can be "sold" to those who are in position to have it put into practice.

We cannot expect men in administrative positions in American agriculture to create, or even think of, all the plans which might be of value to the nation in this emergency, any more than we can expect a general in the army to conceive and develop every strategic move which he employs. The generals study the suggestions offered by any of their subordinate officers, and they use whichever their judgment dictates as most serviceable.

The leaders of American agriculture are in much the same position as the generals in the army; it is their duty to consider every plan suggested by competent aides. Also, the agricultural engineers might be compared to the colonels, majors, captains, and lieutenants.

If Secretary Wickard were to call on the American Society of Agricultural Engineers to work out the details of a plan, such as that mentioned, the members would fall to with a will and do the job. If the group attending this meeting, after careful consideration, decides such a program would have possibilities in this section of the country, why not develop it at once and submit it through the proper channels? If anything of this kind is to be done, the sooner it is done the better.

A good example of one possibility of reducing farm labor without reducing production was given at Memphis, Tenn., early in February of this year, during a meeting of the Southern Section of A.S.A.E. held in conjunction with the annual convention of the Association of Southern Agricultural Workers. A picture was thrown on the screen showing a man turning under a crop with a one-mule plow; you know what kind of work such an outfit would do without having it described to you. The next picture showed a man doing the same operation with a two-mule plow. The second man could not only do twice as much work per day as the first, but also do a much better job, which could be expected to give an increased yield.

At the time these pictures were shown, the comment was made that it would be better if half the men using one-mule plows went fishing while the other half used all the mules on two-mule plows, since the work would be done just as fast and also done better. A much more pertinent comment would have been that half the men using one-mule plows should be transferred to war industries while the other half used two-mule plows.

Someone may argue that the one-mule plow will prepare all the cotton acreage one man can pick, hence inefficiency in seedbed preparation is unimportant. That might have been sound before Pearl Harbor, but it is a different story now. Certainly some means can be evolved for solving the harvesting problem without keeping hundreds of thousands of men worse than idle for three-fourths of the year. And they are worse than idle when they are doing only a fraction of a real day's work, and doing poor quality work at that.

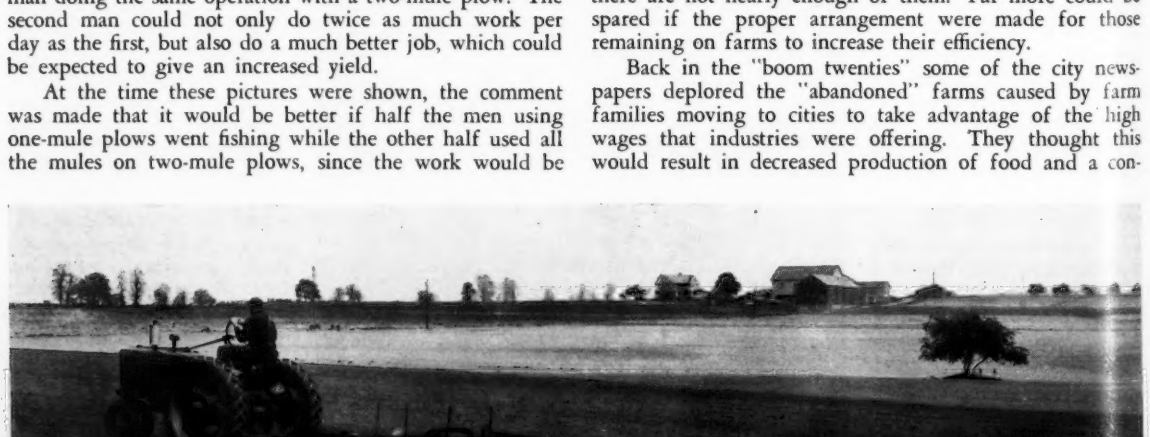
That is the key point of the whole proposition—that is, wherever one man can do what two or more are now doing, plans should be worked out to transfer the unnecessary workers to war industries or other agricultural areas where their labor would be far more useful in the nation's war effort. If this war continues as long as many supposed authorities are predicting, we simply cannot afford to have large numbers of able-bodied men directing one-mule power a few days each year, when they could just as well be on jobs in some war industry where they could work throughout the year on machines using several horsepower each and turning out war goods at a rate proportionate to the power used.

There are many isolated cases where this very thing has happened. Why should it not be possible to bring it about on a greatly increased scale? Certainly, if it is to be done, it is the job of the agricultural engineers to do it.

In no other industry is there such a vast reservoir of inefficiently used labor as exists in agriculture. This is no reflection on agricultural engineers. They have known—and preached—for years that our agricultural production could be turned out by a fraction of the workers actually engaged. But lack of employment in other industries not only kept many on farms, but sent thousands back to subsistence farmsteads. We had to soft-pedal farm labor-saving activities.

Today that situation is practically reversed. Thousands of workers are leaving the farms to re-enter industry, but there are not nearly enough of them. Far more could be spared if the proper arrangement were made for those remaining on farms to increase their efficiency.

Back in the "boom twenties" some of the city newspapers deplored the "abandoned" farms caused by farm families moving to cities to take advantage of the high wages that industries were offering. They thought this would result in decreased production of food and a con-



Where one farm worker can do what two or more are now doing, the unnecessary workers should be transferred to war industries or other agricultural areas where their labor would be far more useful in the nation's war effort

Agricultural engineers might well establish standard work units or norms as a means of comparing the relative efficiency of different farms. By such means individual farmers could calculate their own efficiency, and by giving more attention to utilizing more efficient equipment and methods, they would make their farms more economic units

sequent rise in the cost of living in cities. However, studies in Michigan and in some of the corn belt states showed it to be the actual fact that farms which these migrating workers left were not abandoned by any means. The houses were often vacant, it is true, but the land was being fully cultivated and quite often better cultivated than before.

The reason for this was that neighboring farmers, who were usually better farmers than those leaving, bought or rented the vacated farms and worked them along with their own, often without buying any new equipment or hiring any extra help. They were more efficient and more prosperous than before. Many of the expanding farmers, although by no means all, were tractor farmers, while most of the vacating farmers had used horses. A great many tractor farmers today could easily handle more acreage than they now own or rent, if it were available.

The point is that even in peacetime we have had large movements of families from the farms to the cities without reducing farm production. Is it not reasonable to assume, therefore, that this could be done in wartime on an even larger basis if properly engineered?

In order to compare the relative efficiency of different farms, it would be highly desirable to establish work units or norms which could be used for this purpose. The need for such units has been felt for many years by various groups engaged in studying agriculture. Agricultural economists have made use of "gross income", "net income", and "labor income" for such comparisons. These not only require complete records of a farm business for a full year, for their determination, but are also open to several other objections. They are not at all satisfactory for the kind of comparison under discussion.

From the information agricultural engineers already have at their command, as a result of the studies of Dr. J. B. Davidson and others, previously mentioned, it should be possible to establish norms for all the various field operations. This would permit a quick totaling of the amount of work done on any given farm for which the acreage of each crop and the operations performed were known. After the total work units for a farm was determined, the total per worker could of course be easily obtained by dividing the total by the number of workers employed. The latter figure should furnish a fairly accurate basis for comparing the relative efficiency of different farms so far as crops are concerned.

Establishing such units for the labor involved in handling livestock would doubtless offer greater difficulties, yet it should be possible of accomplishment by utilizing the detailed records which agricultural economists have obtained in many states.

To explain in a little more detail how the use of standard work units might be employed for purposes of comparison, let us suppose that the basis for calculating the units for each field operation is the amount of work done with a two-plow tractor. Offhand it would seem that this might be as satisfactory a base as could be found since it represents a size of power unit most commonly used and on which there is probably the greatest amount of information available. Suppose again that we let plowing one acre of ground represent one hundred of the new units, for which, by the way, someone should coin a suitable name. We will assume, just for illustration, that disking is done at four times the rate for plowing, although actual study of the data may show that either a higher or lower figure should be used. If we use four, then the work units required in disking one acre is one-fourth that for plowing one acre, or 25 units. Planting would probably be about the same as disking, so let us assume a value of 25 work units per acre for planting. It may be found that cultivating is accomplished about five times as fast as plowing, in which case the work units for each acre cultivated once would be 20 work units.

After such standards have been worked out, it would be a simple matter to arrive at comparative figures for the amount of work actually accomplished per man on different farms. The totals for farms where one-horse or two-horse implements are used would be very low in comparison with larger farms using either larger teams or tractors. With such standard units, it would be possible for the first time to make a reasonably accurate comparison of the efficiency of farms and farm labor without detailed records.

It does not require much stretching of the imagination to predict that if such a method is worked out and given the right kind of publicity, individual farmers will calculate their own efficiency and compare it with that found on better equipped and managed farms, with the probable result that they will give more attention than ever before to utilizing the most efficient equipment within their means, and to renting or buying additional land if that is necessary to obtain a more economic unit.

One thing is certain—adjustment of labor between farm and industry is absolutely imperative. An adjustment can be ordered which would result in untold civilian hardship and might jeopardize our war effort and even the outcome of the war itself. On the other hand, an "engineered" adjustment is possible whereby all labor is used most advantageously. You can do it. Will you? "The time is later than you think". Immediate action is necessary. *(Continued on page 125)*

Rural Fire Prevention

By Henry Giese
FELLOW A.S.A.E.

THE conservation of human life and the prevention of economic waste should be of primary concern to a nation at any time. The importance of the problem is, however, greatly increased during a time when every effort is being put forth toward winning a world war. As contrasted with the European nations, America has had little to boast of in her fire waste record.

Numerous agencies are at work on fire prevention in general, and the agricultural engineer has a great opportunity for reducing unnecessary fire waste in farm and rural communities.

This paper deals largely with a study and subsequent action programs in Iowa. Because it has seemed to the author that much fire prevention effort has been vague and intangible, special effort has been made to isolate specific causes of fire waste to determine remedies for these causes and to concentrate on them. It is probable that conditions in Iowa do not differ greatly from those in similar rural areas.

Data for the fire study have been taken from records in the Iowa state fire marshal's office. The laws of Iowa require certain city, town, and township officials to report fires occurring within the area of their jurisdiction. While it is conceded that the figures are incomplete because of some failure to report, it is believed that the omissions are in general small and were they included would add little to the economic waste. Fires occurring only in the rural areas comprising towns of less than 2500 population and on down to farms have been included. To date (March 1942) more than 23,000 such fires have been recorded. Extensive statistical analyses have been made.

The loss experiences and financial records of more than 150 county mutual insurance organizations operating in Iowa have been compiled for a period of more than 50 years. During 1940 a study of human casualties and loss of livestock was made from fire clippings from all Iowa newspapers.

Additional work has been carried on in connection with wood shingle roof fires. From numerous ignition tests, the size of soot particle necessary to cause ignition of wood shingles under favorable conditions was determined. A non-clogging spark arrester has been developed, extensively tested, and patented. Numerous publications have been issued.

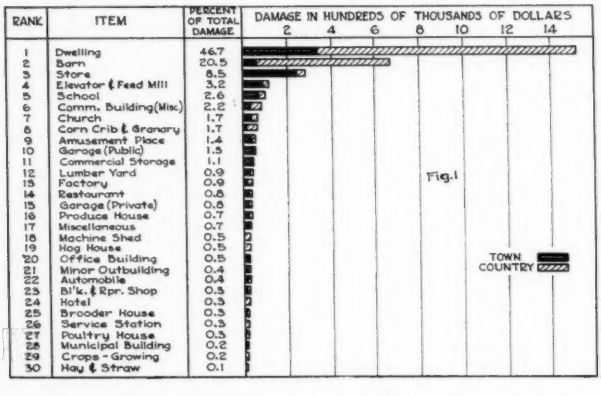
The action programs developing from the study consist primarily of inspection work carried on by the mutuals of Iowa and by farm youth organizations such as 4-H Clubs and Future Farmers of America.

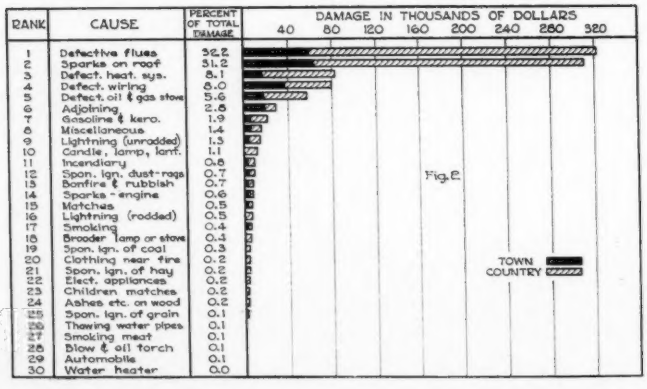
The Fire Waste Problem. An analysis of the fire waste figures for Iowa covering the ten-year period 1930-39 discloses many interesting as well as pertinent facts. In making comparisons, the term "rural" includes everything from isolated farms to towns of 2500 population. Country includes small unincorporated towns and groups of houses. Country and farm are not synonymous as country includes numerous commercial and social structures as well as nonfarm dwellings.

Because of difficulties in extinguishing fires on farms, we are perhaps more concerned over country fires than town fires, and also over the strictly farm fires rather than those occurring in small communities.

From Fig. 1 it will be noted that a large percentage

Paper presented December 2, 1941, at the fall meeting of the American Society of Agricultural Engineers at Chicago, Ill. A contribution of the Farm Structures Division. Journal Paper No. J-995 of the Iowa Agricultural Experiment Station, Project 23; in cooperation with the Iowa Mutual Tornado Insurance Assn. and the Farmers' Mutual Reinsurance Assn. Author: Professor of agricultural engineering, Iowa State College.




RANK
CAUSE
PERCENT OF TOTAL DAMAGE
DAMAGE IN THOUSANDS OF DOLLARS
40 80 120 160 200 240 280 320
1 Defective flues 32.2
2 Sparks on roof 31.2
3 Defect. heat. sys. 8.1
4 Defect. wiring 8.0
5 Defect. oil & gas stove 5.6
6 Adjoining 2.6
7 Gasoline & kero. 1.9
8 Miscellaneous 1.4
9 Lightning (unradded) 1.3
10 Candle, lamp, lant. 1.1
11 Incendiary 0.9
12 Spon. ign. dust-rags 0.7
13 Bonfire & rubbish 0.7
14 Sparks - engine 0.6
15 Matches 0.5
16 Lightning (radded) 0.5
17 Smoking 0.4
18 Brooder lamp or stove 0.4
19 Spon. ign. of coal 0.3
20 Clothing near fire 0.2
21 Spon. ign. of hay 0.2
22 Elect. appliances 0.2
23 Children matches 0.2
24 Ashes etc. on wood 0.2
25 Spon. ign. of grain 0.1
26 Thawing water pipes 0.1
27 Smoking meat 0.1
28 Blow & oil torch 0.1
29 Automobile 0.1
30 Water heater 0.0
Fig. 2
TOWN
COUNTRY

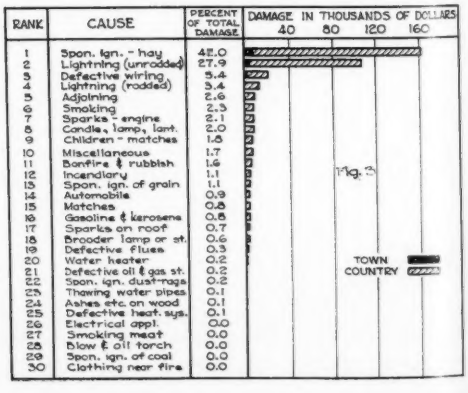

RANK
CAUSE
PERCENT OF TOTAL DAMAGE
DAMAGE IN THOUSANDS OF DOLLARS
40 80 120 160
1 Spon. ign. - hay 42.0
2 Lightning (unradded) 27.9
3 Defective wiring 5.4
4 Lightning (radded) 3.4
5 Adjoining 2.6
6 Smoking 2.3
7 Sparks - engine 2.1
8 Candle, lamp, lant. 2.0
9 Children - matches 1.8
10 Miscellaneous 1.7
11 Bonfire & rubbish 1.6
12 Incendiary 1.1
13 Spon. ign. of grain 1.1
14 Automobile 0.9
15 Matches 0.8
16 Gasoline & kerosene 0.8
17 Sparks on roof 0.7
18 Brooder lamp or st. 0.6
19 Defective flues 0.3
20 Water heater 0.2
21 Defective oil & gas st. 0.2
22 Spon. ign. dust-rags 0.2
23 Thawing water pipes 0.1
24 Ashes etc. on wood 0.1
25 Defective heat. sys. 0.1
26 Electrical appl. 0.0
27 Smoking meat 0.0
28 Blow & oil torch 0.0
29 Spon. ign. of coal 0.0
30 Clothing near fire 0.0
Fig. 3
TOWN
COUNTRY

Fig. 1 (Upper left) Rural fire damage by item (yearly average, 1930-39) • Fig. 2 (Lower left) Rural dwelling fire damage from known cause (yearly average, 1930-39) • Fig. 3 (Below) Rural barn fire damage from known cause (yearly average, 1930-39)

of the fire waste is included under a comparatively few headings by buildings. In the rural communities, the dwelling, farm barn, store, elevator and feed mill, and school represent the principal items. If commercial and other definitely nonfarm buildings are excluded, we find that 93 per cent of all country fire waste occurs in dwellings and barns. Of this the dwelling accounts for 61 per cent and the barn 32 per cent. Greater results in fire prevention will be obtained by concentration upon the dwelling and barn.

In Fig. 2 are shown the known causes of dwelling fires in rural districts. Unfortunately the causes of many fires are either not known or not reported. For this reason, fires of unknown origin have been omitted from the analyses. Of the many causes responsible for some dwelling fires, thirty have caused a sufficient number to be listed by the state fire marshal. Of these, however, five stand out far above the remainder in total damage done. These are, in order, flues, sparks on roof, heating systems, wiring, and oil and gas stoves. After inspecting many farm dwellings, it is our belief that discrimination between defective flues and heating systems may be difficult and the two should be combined under one head. When so combined, we find that defective flues and heating systems are responsible for 42.9 per cent of the total damage to country dwellings, while sparks on roofs cause 32.7 per cent.

A similar situation exists with reference to barn fires. While thirty causes are reported to the state fire marshal, spontaneous ignition of hay and straw and lightning to barns not provided with rods stand out above all the others in the extent of damage done. Considering farm barns only, 42.7 per cent of the damage results from spontaneous ignition and 28.5 per cent from lightning to rodded barns. It is roughly estimated that one-half the barns are provided with lightning protection. Many of these are defective and may actually increase the hazard. Notwithstanding the fact, however, the rodded half contribute only 12 per cent as much damage as the unrodded half.

The general trend in the total fire waste has been downward during the ten-year period (1930-39). Of the four principal causes listed, defective flues and heating systems have definitely dropped, lightning has approximately maintained its level, while spontaneous ignition of hay and straw shows a definite trend upward.

The peak of fires from defective flues and heating systems is experienced during February, while those from sparks on combustible roofs occur during March. Spontaneous ignition strikes hardest in July, while the peak of lightning fires is in August.

Iowa has definite fire areas. Fig. 6 shows by counties the average number of fires annually per 1000 farms. As previously mentioned, not all country fires are farm fires, and hence the story may not be altogether fair to the farmer. It will be noted, however, that Monroe County with an average of 9.4 fires per 1000 farms experiences more than five times as many fires as Winneshiek County with only 1.8 fires per 1000 farms. Analysis of fire waste in other states may show also that fire prevention effort should be directed toward certain areas.

The spreading of fire from one building to another does not appear to be a serious problem in Iowa. Either fire fighting equipment is available and effective or buildings are sufficiently separated that but few buildings are ignited from adjoining ones. Only 559 such fires were reported to the state fire marshal during the ten-year period, or 0.5 per cent of all country fires. Here again the principal damage is done in small unincorporated settlements rather than on the farm. Seven counties report no adjoining fires for the ten-year period. A fire-fighting program which was expected to show results by preventing the spread to other buildings, would probably be unprofitable in a large portion of Iowa. In general, fires originate in the larger buildings such as the house and barn and spread to the smaller ones such as the garage or hog house.

The greatest fire waste per dollar invested in buildings occurs in the areas with the lowest investment. Country fires are likely to burn to exhaustion. In towns the damage averaged 26.1 per cent of the value, while in the country the damage was 72.1 per cent of the value.

Fire Casualties in Iowa (1940). So much has been said about the economic waste caused by fire that we may lose sight of the human side. Should not human values be placed above money, and an effort made to stop the loss of life and intense suffering resulting from serious fire injury? When we realize that nearly every day in the year, fire brings either death or injury to some one in Iowa alone, the need for preventing such fires becomes more apparent. The U. S. Bureau of the Census reports an average of 13,086 deaths from conflagrations and burns for the two-year period (1935-36).

According to the findings of this study, 357 fires resulted in 77 deaths and 366 injuries in Iowa for the year 1940. The majority (70.8 per cent) of these fires resulted in only one injury. In one instance, three deaths and five serious injuries resulted from one fire.

The farmer is often lulled into a false sense of security when he thinks that most of the fire deaths are occasioned by large city conflagrations which trap persons in burning buildings. Twenty-seven of the 77 deaths reported or 35.1 per cent of the total, occurred on the farm; 21, or 27.3 per cent, occurred in town, and the remaining 29, or 37.6 per cent occurred in the city. Rural population in Iowa comprises 57.3 per cent of the population according to the 1940 census report, and 62.4 per cent of the deaths are in rural communities.

In the year 1940, 49.2 per cent of the known causes of deaths from fire were the result of the careless use of gasoline, kerosene, or other inflammable liquids, or of clothing becoming ignited when the wearer moved too close to a stove or bonfire. These two causes

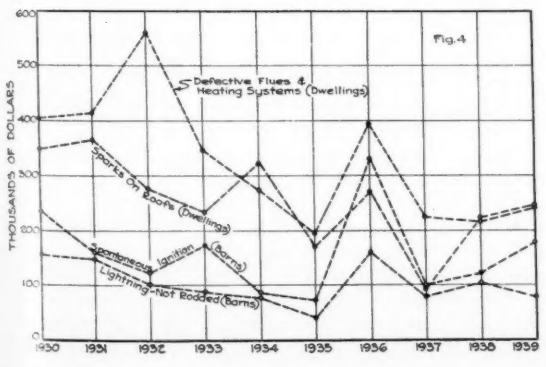
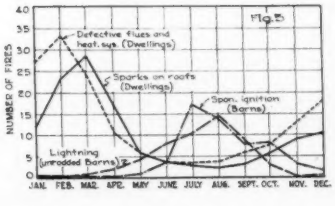


Fig. 4 (Left) Country fire trends by years in Iowa; loss resulting from four principal causes • Fig. 5 (Below) Country fires from four major causes, by month of occurrence (yearly average, 1930-39)



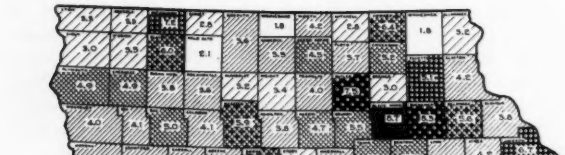


Fig. 6 Country fires per 1,000 farms (yearly average, 1930-39)

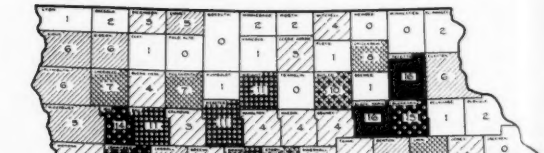


Fig. 7 Country fires in Iowa ignited from adjoining buildings (ten-year total, 1930-39)

are perhaps more prevalent in a rural community where small quantities of gasoline or kerosene are kept on every farm, and where most of the heating is done by means of stoves. Some of the fires resulting from nearness to a stove were started when the victim was putting fuel on the fire. Several of the gasoline and kerosene fires were a result of attempts to hurry the fire by throwing these extremely volatile and inflammable liquids on the open flame.

The farm contributes more than its share of tragedies from the use of a lantern for lighting while filling the automobile or the tractor at night. To bring any open flame close to vaporized gasoline is to invite death. It seems incredible that in spite of all the information available on the safe handling of gasoline, we still have 14 out of the total 27 farm deaths occurring as the result of the careless use of inflammable liquids. The common use of such liquids tends to minimize regard for their potential danger.

Standing too close to a stove or a fire has been mentioned as the second ranking cause of deaths from fire. It is interesting to note the large number killed, in comparison to the population, between the ages of 70 and 90. Old people living alone seem to be the most frequent victims. More children under ten die than any other group, but the percentage is less because of the larger number of children in relation to the population as a whole.

Only those injuries definitely requiring medical attention or hospitalization have been included in this study. Careless use of gasoline and kerosene again heads the list as a cause of injuries. Counting those from gasoline and kerosene stoves in with the injuries from gasoline and kerosene and other highly flammable liquids, a total of 36.1 per cent of all injuries from fire will be included in this one menace.

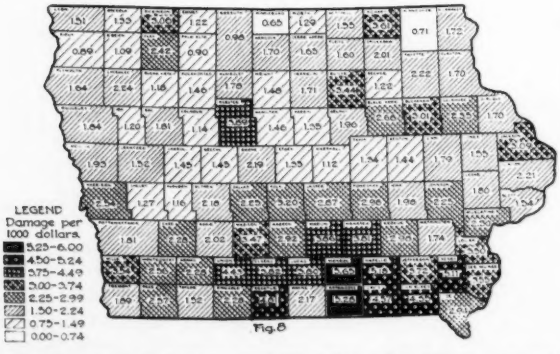


Fig. 8 Country fire damage per 1,000 dollars of building investment, 1930 census (yearly average, 1930-39)

The second greatest cause of injury from fire was from fighting fire. One-half the injuries from fighting fire occurred in rural communities. This ratio is not significantly different from the population distribution. Only one of the men injured while fighting farm fires was a professional fireman. Fifteen firemen were injured in fighting town and city fires. Several persons were burned when they endeavored to extinguish flames from another person's clothing.

Approaching too closely to a fire or stove is often a tragic mistake. Women's skirts or lacy dress trimmings are easily kindled but difficult to extinguish.

Out of the injuries from gasoline and kerosene, 17 of the total of 121 were the result of throwing kerosene or gasoline on the fire to make it burn more briskly.

About one-half the fires resulting in livestock deaths are from unknown causes. Usually these fires attain considerable headway before they are discovered, and any evidence of the cause is destroyed by the flame. Lightning is the principal known cause of livestock losses.

Defective brooder stoves cause many fires in the early spring months. Most of the 45,500 baby chicks killed were lost from this cause alone.

The fires classed as miscellaneous were caused by lantern carelessness, ignition from adjoining building, playing with matches, sparks from hay carrier track igniting a bird's nest, explosives, and a fire in a railway car containing baby chicks.

The kinds and number of livestock lost from fire in Iowa in 1940 are as follows:

Kind of stock	No. Lost	No. of Fires	No. Lost per Fire
Horses and mules	200	59	3.4
Cattle	531	87	6.1
Hogs	1,254	68	18.5
Sheep	439	6	73.2
Dogs	13	12	1.1
Poultry (exclusive of baby chicks)	6,695	42	159.3
Baby chicks	45,561	71	642.0

Fire Prevention. In rural communities and especially in the country, it would seem very important to attempt to prevent ignition of fires which might destroy buildings or human life. Protective measures are much less effective in the country than in the city.

Even during the midnight hours passers-by are frequently able to identify and report city fires. Help is close at hand and protective measures applied before the fire gains headway. In the country fires occurring at midday may not be discovered until too late to do more than remove the contents of the building.

Many country homes do not have telephone service. Rural telephone exchanges often do not employ night operators. A sleeping operator must be roused sufficiently to

spread the alarm to a scattered volunteer fire department. Some of these departments are not authorized to leave the village unprotected while they go to fight a country fire. The fire grows in intensity while the volunteer department is getting dressed and down to the station. Then the question is, Where is the fire? Articles in fire prevention journals endeavoring to point out methods of hastening the solution of this problem indicate that valuable time may be lost in determining the proper highway to take and the shortest possible route. The peak of fires in Iowa occurs at the time in late February and early March when country roads are at their worst. When the surface has thawed but frost still exists below, gravelled roads may be so slippery that a truck must proceed slowly and with caution. Should the fire truck get to the scene of the fire in time to be effective, it may still fail unless a large supply of water is available.

From a 12-year study of fires in Iowa, we believe that not only can fires be prevented if the proper approach is made, but that fires have been and are being prevented in ever-increasing number. If practically all farm loss occurs to dwellings and barns, the approach can be simplified and other outbuildings largely eliminated from consideration. It is much easier to carry out a program limited to the two principal structures on the farm than to extend it to all. While we would not overlook several causes responsible for considerable damage to farm dwellings, we feel likewise that concentration on a few will bring results while scattering over many becomes confusing.

Fortunately the two important causes of dwelling fires are structural and easily identified. Any competent inspector can tell whether a chimney or heating system presents a hazard. If the owner is not sufficiently concerned because of his own chances of loss to do something about it, the insurance company can put on pressure. The effectiveness of such inspections in creating fire consciousness is interesting. Reinspections after a 5-year period show that, to a remarkable degree, householders have not only removed the hazards but have prevented their recurrence.

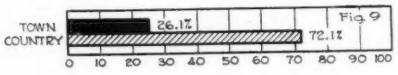
The second major cause of dwelling fires is also easily identified. Wood shingles laying flat or prepared roofings well protected by mineral surfacing, are not easily ignited by embers discharged from the house chimney. There is little danger on the farm from flying embers from other buildings. Even the uninitiated can tell when a wood shingle roof is warped and checked or the mineral surfacing of a prepared roof is gone so that a serious hazard exists. Should the owner feel that he cannot afford to reroof with something more fire-resisting, he can at very small cost purchase a spark arrester which will be effective in preventing sparks of dangerous size from escaping from the chimney. Since a clogged spark arrester may cause serious smoke damage, care should be exercised in getting a nonclogging type.

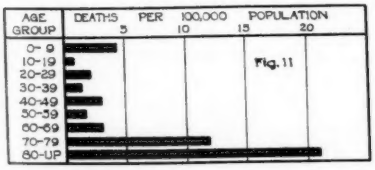
Prevention of barn fires is likewise simplified in that two causes result in a large part of the damage. Properly installed lightning rods are credited with being almost perfect protection against damage. Both the U. S. Department of Agriculture and the National Fire Protection Association have published standards for such equipment and instructions for installation.

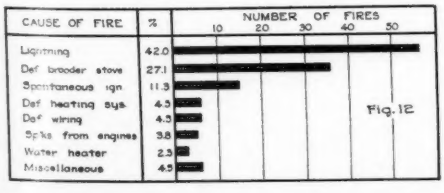
The second cause of barn fires is not so easily controlled, as it is a problem of management and not associated directly with the structure. Farmers should be reminded frequently of the hazard of spontaneous ignition and advised not only how to take care of harvesting in the most approved manner but also what to do in case the hay shows signs of heating. Under no circumstances should the hay be removed from the barn until the fire department is at hand and ready to act. Care should be taken not to walk on the hay, except on a plank which would prevent one from dropping into a burning inferno. In addition, it would be well worth while to smother the fire with carbon dioxide to prevent the hay from bursting into flame when removed from the mow.

Since dwelling fires occur principally in the winter and barn fires principally in the summer, effort can be further concentrated to include only one item at any particular season.

Action Programs. Fire prevention information furnished the leaders of the 4-H Clubs and Future Farmers of America has resulted in an extensive inspection program. Prizes have been offered by the Farmers Mutual Reinsurance Association and by some of the county mutuals. This work is developing a fire consciousness which must be far-reaching in its effects. Short courses have been offered for electrical inspectors, and one is now being planned for insurance agents. The research project has furnished the stimulus and necessary technical information for an inspec-







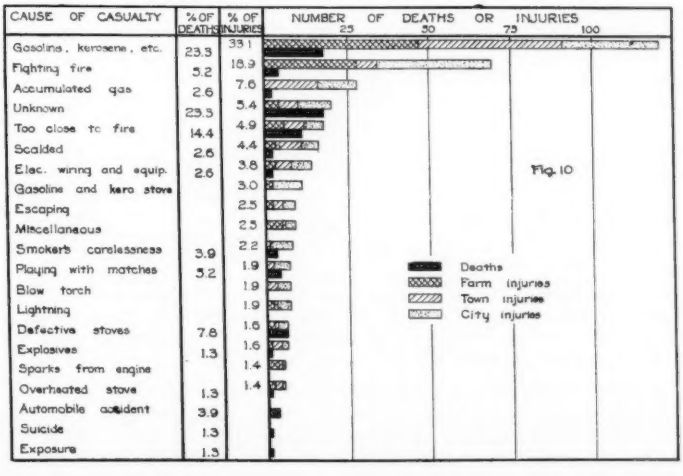


Fig. 9 (Left, top) Per cent of valuation damaged; extent of demolition (value/damage) (Yearly average, 1930-39) • Fig. 10 (Right) Causes of fire casualties (Iowa, 1940) • Fig. 11 (Left, center) Deaths per 100,000 population by age groups (Iowa, 1940) • Fig. 12 (Left, bottom) This graph shows the known causes of fires resulting in livestock loss (Iowa, 1940)

tion bureau sponsored by the Farmers Mutual Reinsurance Association and jointly financed by the Iowa Mutual Tornado Insurance Association. This work originating under the direction of Earl D. Anderson is now being ably continued and expanded by L. G. Keeney. Many poor wind risks have been cancelled and fire hazards removed. The underwriting of many Iowa agents will be beneficially affected and tangible results will not represent the full benefits derived.

The following extract from a report prepared by L. G. Keeney, assistant secretary of the Farmers Mutual Reinsurance Association, on June 17, 1940, gives some idea of the extensiveness and effectiveness of the inspection; work since this report is comparable to that preceding:

"The number of hazards corrected is based on percentages found during the past few months since we have had the report forms which come to this office in shape to record the number of corrections made. As the inspectors have done about the same amount of repair work in earlier years, we believe that the figures for the number of hazards corrected will be consistent and substantially correct.

"The following comments and explanations are made to clarify the summary and to assist in its interpretation:

"*Roofs.* Forty-one per cent of the dwelling roofs inspected during 1938 and 1939 were found to have wood shingles which were considered unsafe. The percentage corrected, 84.3 per cent, includes only those dwellings where spark arresters have been installed on all chimneys in use or likely to be used. The inspector is sometimes unable to make the installation because of the fact that the chimney may need repair before the arrester can be installed. We also find a number of cases where flimsy tin extensions have been placed on brick chimneys making the installation of the arresters impossible.

"*Chimneys.* The summary shows that 24 chimneys were found defective above the roof for every 100 dwellings inspected. There would of course be cases where more than one chimney on the same dwelling is defective, but we have no means of keeping this information straight. In view of the fact that each defective chimney represents a separate hazard, it appears logical to say that 24 dwellings out of every one hundred have a chimney defective above the roof, 23 per cent defective in the attic, etc. A serious condition is represented by the estimate that 26.5 per cent of our dwellings have one chimney inaccessible to inspection in the attic. It could naturally be expected that a far larger percentage of these inaccessible chimneys would be defective than of those which the inspector is able to see.

"*Lightning Protection Systems.* We do not have accurate information as to the number of major farm buildings equipped with lightning protection systems. An early estimate indicates that approximately 50 per cent of the major buildings are rodded. The summary shows that we have found 25.8 per cent broken ground connections for every one hundred sets of buildings inspected. If only 50 per cent of the major buildings are rodded, it naturally follows that a very high percentage of the existing installations are substandard.

"*Heating Systems.* The item under heating systems listed as 'flue fittings' included all junctions of smoke pipes with chimneys, also clean-out holes and other man-made chimney openings. The inspectors are not able to make many corrections on heating systems, except to install safe flue stops if the policyholder is willing. The item 'stoves, furnaces' includes defective heating plants. 'Clearance' includes all cases where pipes, stoves, or other heating equipment are sufficiently close to combustible walls, ceilings, or partitions to be called unsafe.

"*Electrical Wiring.* As mentioned earlier, the estimate of 36.1 per cent as the number of farms having electrical wiring in proportion to the total number of risks inspected may be too high for a fair picture of the electrical installations inspected since 1934. However, since a considerable amount of new work has been found to be defective, we feel justified in using this figure for the purpose of comparison."

Many thousands of spark arresters are being installed with a minimum of difficulty involved. A spark arrester is at best an attempt to remedy a bad situation, and while relatively trouble free may continue to present some problems. Wet snow falling when the fire is low or condensation on the wire mesh can scarcely be controlled.

INSPECTION SUMMARY
FARMERS MUTUAL REINSURANCE ASSOCIATION
Grinnell, Iowa

Period covered: May 15, 1934 to December 31, 1939

Inspections made:

Year	No. Inspections
1934	4092
1935	7313
1936	7970
1937	8443
1938	12660
1939	12998
Total	53476

Hazards	Per cent of Total	Number of Hazards	Per cent Corrected	Number Corrected
Roofs	41	21921	84.3	18,479
Chimneys				
Above roof	24	12834		
In attic	23	12299		
Inaccessible in attic	26.5	14171		
Lightning Protection Systems				
Air terminals	17.3	9251	36.2	3,349
Conductors	13	1604	14.7	236
Ground connection	25.8	13797	41.5	5,726
Metal connection	36	19251		
Heating Systems				
Flue fittings	23.8	12727	11.6	1,476
Stoves, furnaces	1.1	588		
Smoke pipes	10	5354		
Clearance	16.6	8877		
Electrical Wiring				
Farms wired	36.1	19305		
Fuses	74	14286	85.3	12,186
Insulation	30	5791	18.5	1,071
Support	27	5212	20.2	1,052
Fixtures	10	1930		
Grounds	11.5	2220		

The prevention of farm building losses from wind and fire is now regularly included in farm building courses at the Iowa State College.

About ten years ago the building manual committee of the Iowa Association of Mutual Insurance Associations undertook the compilation of material which would be usable to association members in appraising the value of farm buildings and in identifying and removing wind and fire loss hazards. While manuals for use in cities particularly in connection with commercial buildings were available, they were not readily adapted for use in the rural communities of Iowa. Problems resulting from a rapid decline in land and building values accentuated the need for a more equitable settlement of such losses.

The first undertaking was a simplified inspection blank which permitted easy and quick appraisal of conditions on the farmstead on which it was made.

In 1933 the Iowa Mutual Tornado Insurance Association published a small 14-page manual prepared by the author and Earl D. Anderson. Copies of this manual were distributed upon request from association members throughout the state. This manual, although a step in the right direction, was entirely too brief to cover the subject and quite inadequate to take care of the demand resulting from an ever-increasing consciousness of the need for more systematic inspections and appraisals and the benefits to be derived therefrom. In 1938 a much more comprehensive manual prepared largely through the efforts of L. G. Keeney of the Farmers' Mutual Reinsurance Association incorporated data on wind and fire losses developed from researches herein mentioned. Tables of unit costs of building materials and labor estimates were accompanied by a cost analysis of several typical buildings in the Midwest Farm Building Plan Service. This edition was published by the Farmers' Mutual Reinsurance Association and made available to interested parties in Iowa and elsewhere.

The use of this publication has been extended far beyond the political boundaries of our state, and has not been limited to inspection and appraisal as a basis for writing and adjusting fire and wind insurance. The Federal Land Bank of Omaha, life insurance companies, and other

large land-holding organizations have found it useful. Colleges are now using it as a supplementary farm buildings text.

Rural Fire Protection. While emphasis has been placed on fire prevention for reasons given, there is no desire to interfere in any way with adequate fire protection. We feel, however, that equipment and organization for fire protection should be on a basis of prevention plus and in no way result in a lessening of prevention effort. There is much danger that a farmer may feel a false sense of security if he is eligible to service from a fire-fighting unit from a nearby town and fail to use reasonable care in preventing fires. The feasibility of the purchase and maintenance of rural fire-fighting equipment is a matter of judgment. Where local regulations or state laws prevent city fire departments from going into the country, special arrangements must be made. Help in organizing and in purchasing equipment can be obtained from the state fire marshal and from the National Fire Protection Association. Equipment in town should be augmented by adequate telephone service, good highways, and a farm water supply.

SUMMARY

A large percentage of rural fires are the result of a few easily preventible causes. Nearly all of the fire waste on farms is in connection with dwellings and barns. Much can be accomplished if flues and heating systems are in good shape and all hazardous roofs are protected by spark arresters on the chimneys.

Well-rodded barns and careful management in haying will prevent barn fires.

Dwelling fires occur primarily in winter while most barn fires occur in the summer.

Iowa at least has definite fire areas. It would be profitable to concentrate on such rather than to operate indiscriminately on a state-wide basis.

Old persons, above 60 years, or young persons, below 10, are the most likely to be killed or injured by fire.

The greatest number of deaths, injuries, and livestock losses from fire do not occur at the same time as the greatest fire waste nor from the same causes.

The spring and early summer months are the most dangerous in regard to fire deaths and injuries in Iowa for the year 1940.

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Engineering in Wartime Agriculture

(Continued from page 119)

Such a program is part and parcel of engineering in wartime agriculture. Its immediate effects—well, if it is done from an engineering standpoint, its present effects will be a major part in providing our nation with the largest armed forces, the most war materials in the right places, and the necessary food to keep armed forces and civilians alert and on their toes. And as to its future effects—the success achieved during the emergency will become permanent and blaze the way for further progress after "food has written the peace."

You as agricultural engineers have studied and are trained for an opportunity of special service. Here is the greatest one you have ever had or probably ever will have. Not only a golden opportunity, but a responsibility as well. Will you meet the challenge? On time? May it never be said of the service of the agricultural engineer in this national emergency: "Too little, and too late!" Rather may it be written in future records of agricultural engineering that the present situation was the beginning of a great era of achievement, the "Magna Charta" of agricultural engineers.

Distribution of Corn Yields on Farm Terraces on the Shelby Soil

By A. W. Zingg and D. M. Whitt
MEMBER A.S.A.E.

STUDIES at present being made by Uhland[1] indicate that corn yields on a given soil are proportional to a number of factors, one of which is the depth of surface soil. A limited exploratory study was made by the authors in the fall of 1940 to find (1) if the yield of corn on terraced land is also proportional to the surface soil depth, and (2) how the yield varies throughout the terrace interval.

The study was made on the Shelby soil at the S.C.S. soil conservation field station at Bethany, Missouri. A strip of 100-ft width, extending over three experimental terraces on a 7.2 per cent slope, was selected for the study. The terraces were constructed in 1930 and have been cropped to a 3-yr rotation of corn, oats, clover with timothy. Fertilizer (0-20-0), at the rate of 200 lb per acre, has been applied with each small grain seeding. The center line of the 100-ft strip is a line along which soil movement has been studied by profile leveling, at one-foot distances, between permanent bench marks[2].

Corn was contour-drilled on the terraces, the point rows being placed on the back slope of the ridge on the upper portion of the terrace interval. The horizontal position, total weight of corn, and average surface-soil depth of each drilled row of corn were secured. The corn yield per acre for each row was calculated, using the area comprising the row length and one-half the distance between adjacent drill rows of corn. When point rows were encountered, the yield was combined with an adjacent full-length drill row and the area and row position adjusted accordingly.

A graph of the composite of the surface and subsoil profiles for the three terrace intervals is given in the accompanying figure. Immediately below is a composite of the yield data on the interval. The yield of the row on the terrace ridge top is the average from four ridges. The yield of the row in the channel is the average from three channels. The remaining yield points are a running average of the data secured from three adjacent rows. The graph showing the relationship of surface-soil depth and corn yield in bushels per acre was secured by taking data at regular slope distances from the two graphs above.

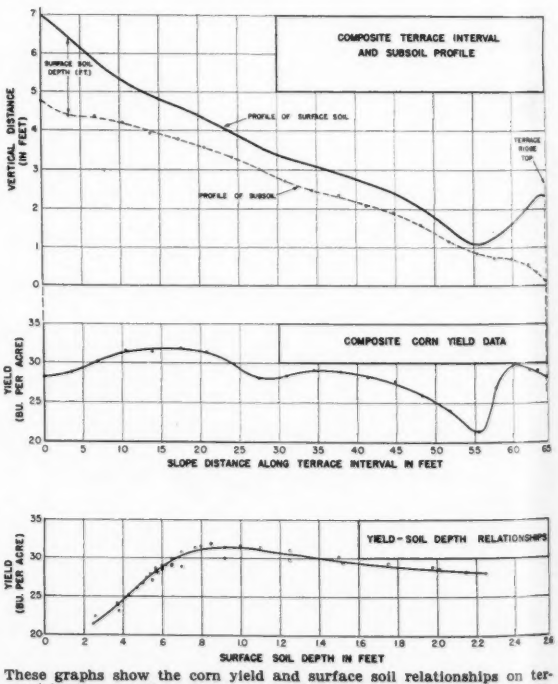
Irregularities of topography, soil depth, and yield data have been smoothed by the process of giving results in a composited graphical form for the three terraces studied. The method also makes possible a quick visual interpretation of the data.

The yield of corn increased with depth of surface soil, regardless of its location on the terrace, to surface-soil depths up to one foot. Soil depths above this figure occur on the terrace ridge, and there was a slight decline in yield for these extra depths of filled-in surface soil. Observations during the last few years indicate that a portion of the soil in the terrace ridge, lying above the level of the channel, has received little, if any, moisture by infiltration from the surface of the ridge, or by lateral movement from the terrace channel. In securing soil depths on the terrace ridge for this study, an extremely dry zone of soil was found. It is evident that the moisture content of terrace ridges merits further attention.

In general the yield of corn increased from an average-yield figure on the ridge top to a maximum at a point just off the terrace back slope, or approximately 15 ft down the slope from the ridge center. This area contained point rows, but increase or decrease in yield due to the point rows was not discernible. The yield declined from this point with progression down the slope to the center of the terrace channel. The yield increased from the channel to a point approximately one-half the distance to the ridge top on the front slope of the terrace berm. It again showed a decline on surface-soil depths greater than one foot on the remainder of the front slope of the terrace.

The decline in yield, occurring midway between the terrace ridge above and the channel below, may be accounted for by the fact that a deadfurrow was left at this point in plowing the field in 1931 and 1933. Subsequent plowing has been with a two-way plow wherein the furrow slice is turned up the slope and the deadfurrow left in the channel.

(Continued on page 128)


COMPOSITE TERRACE INTERVAL AND SUBSOIL PROFILE
SURFACE SOIL DEPTH (FT.)
PROFILE OF SURFACE SOIL
PROFILE OF SUBSOIL
TERRACE RIDGE TOP
VERTICAL DISTANCE (IN FEET)
COMPOSITE CORN YIELD DATA
YIELD (BU. PER ACRE)
SLOPE DISTANCE ALONG TERRACE INTERVAL IN FEET
YIELD - SOIL DEPTH RELATIONSHIPS
YIELD (BU. PER ACRE)
SURFACE SOIL DEPTH IN FEET

These graphs show the corn yield and surface soil relationships on terraced land as found in studies at the Soil Conservation Experiment Station at Bethany, Missouri

Article prepared especially for AGRICULTURAL ENGINEERING, being based on cooperative research in soil and water conservation investigations of the Missouri Agricultural Experiment Station and the Office of Research, Soil Conservation Service, U. S. Department of Agriculture.
Authors: Respectively, agricultural engineer and assistant soil conservationist, Soil Conservation Service, U. S. Department of Agriculture.

[1]Uhland, R. E. Field Method for Evaluating Effects of Physical Factors and Farm Management Practices on Soil Erosion and Crop Yields. Paper presented before Soil Science Society of America, December 1940.

[2]Zingg, A. W. Soil Movement within the Surface Profile of Terraced Lands. AGRICULTURAL ENGINEERING, March 1942.

An Insulated Electric Soil Pasteurizer

By Andrew Hustrulid
MEMBER A.S.A.E.

PASTEURIZATION is the only sure method of having disease-free and weed-free soil for use in the seedbed or flats. It may be accomplished by the application of certain chemicals or by raising the temperature of the soil in the presence of moisture. Raising the temperature and holding it for a short time is considered to be the most effective means for the control of such plant enemies as bacteria, fungi, worms, insect life, and weed seeds.

Two general methods are used to heat the soil electrically: (1) the so-called direct or "internal resistance method" in which the heating is accomplished by passing an electric current through the soil itself, and (2) the indirect or "heater method" in which the heating is accomplished by imbedding insulated heating elements in the soil. Although the first method has certain advantages, such as a more uniform temperature throughout the soil, it has until recently had two disadvantages, namely, a variable electrical load and possible hazard to the operator. S. R. Cruz[3]* has presented a solution of the variable load problem by using a constant current transformer. His results also indicate that the possible hazard to the operator of his method is negligible. Until Cruz's work appeared, only the indirect method of supplying the heat was to be recommended for use by greenhouse and nursery operators.

Article prepared especially for AGRICULTURAL ENGINEERING. Paper No. 1976 Scientific Journal Series, Minnesota Agricultural Experiment Station. Author: Assistant professor of agricultural engineering, University of Minnesota.

*Superscript figures refer to the references appended to this article.

Extensive experimental work by Newhall[1,2] and others has shown that a minimum soil temperature of 150 F (degrees Fahrenheit) in the presence of moisture is sufficient to insure pasteurization against nearly all important plant pathogens as well as most weed seeds. For complete pasteurization, *all* portions of a soil batch must be raised to the minimum temperature, and this must be achieved without subjecting some parts of the batch to excessively high temperatures. Heating soil much above the boiling point of water chars the organic matter and is, therefore, detrimental to the soil. Uneven heating of the soil is the main disadvantage of the indirect method of pasteurizing as pointed out by Blauser[5] and others.

Carney[4], one of the pioneer workers in the field, as early as 1932 suggested what he considered to be the proper design of the indirect type of soil pasteurizer. The requirements for convenient use and good results, approximately as he gave them, are:

1. Construction of the soil box to make filling and emptying easy
2. Good insulation to prevent heat loss and reduce temperature gradients within the soil; the insulation should be permanent, sturdy, and resistant to moisture damage
3. Spacing and temperature of the heating elements so the temperature of the whole mass of soil rises uniformly
4. Dimensions of the unit such that it may be moved through standard doors.

This brief report describes a ½ cu yd pasteurizer (Fig. 1) which fulfills the above requirements. It was designed, built, and tested in the division of agricultural engineering at the University of Minnesota. (Wayne Schober designed

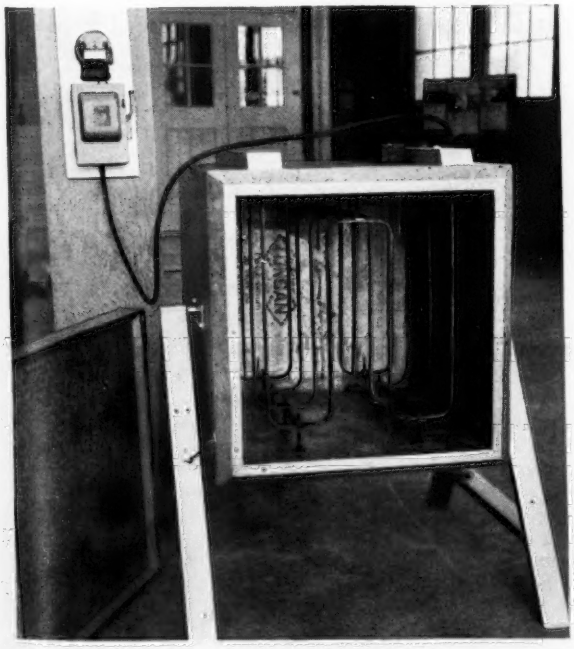


Fig. 1 This view shows the complete pasteurizer tipped down and with gasketed cover removed. The support for the box is placed slightly above center so that even when full of soil it is easily tipped into the position shown

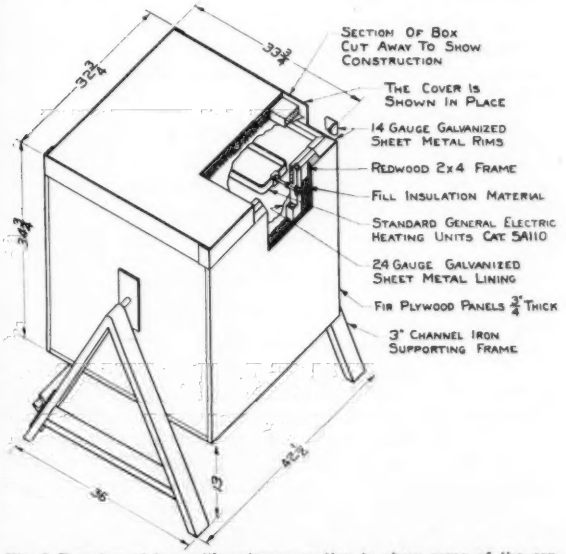


Fig. 2 Drawing of box with cutaway section to show some of the constructional details. The outside dimensions are in inches. With the support removed and the cover off, the box can easily be moved through a standard 36-in door

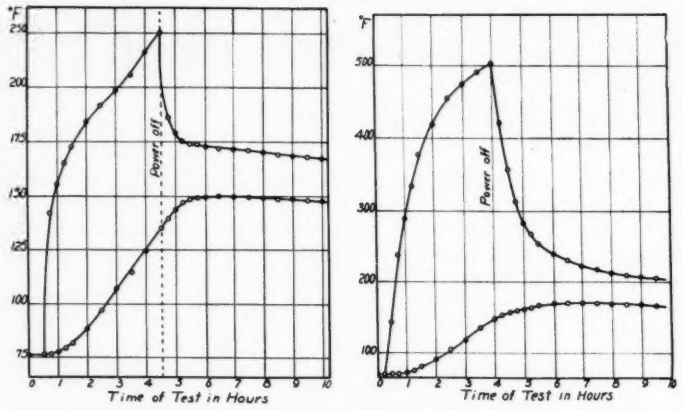


Fig. 3 (Left) Curves showing the variation of temperature with time for heavy loam soil with a moisture content of 22.7 per cent. The upper curve represents the temperature of the soil in contact with the heater strip near center of box; the lower curve that for the soil within an inch of the upper corner. Using the average temperature of the soil two hours after the power is turned off as a basis, the energy consumption was 0.9 kw-hr per cu ft per 90 F temperature rise • Fig. 4 (Right) Curves showing the temperatures for the same soil as Fig. 3 but with a moisture content of 6.6 per cent. The energy consumption in this case was 0.6 kw-hr per cu ft per 90 F temperature rise. The difference in energy consumption between the soil samples of Figs. 3 and 4 is approximately that required to heat the additional water

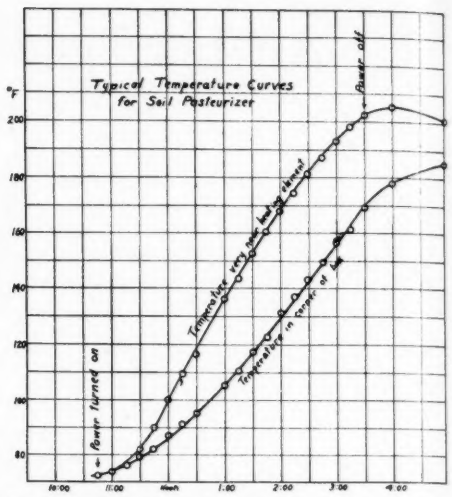


Fig. 5 Temperature curves for a soil mixture of three parts loam, two parts finely pulverized peat, and one part sand. Energy consumption was 0.8 kw-hr per cu ft per 90 F temperature rise

and constructed the unit, and the investigation was aided by the Northern States Power Company through the furnishing of the heating elements and the thermostatic switch.) The cross section inside dimensions are 28x29 in and the depth is 30 in. Fig. 2 illustrates some of the constructional details of the box. The heating unit consists of four 750-w elements manufactured by the General Electric Company. Connections were made so that the heaters could be connected to a 220-v outlet. To test the box, soil samples were placed in it and heated to the required minimum. During a test the temperatures at many points in the sample and the energy and power requirements were recorded.

The temperatures were obtained by using iron-constantan thermocouples arranged for most tests with the junctions placed at 6-in intervals and located on a line connecting the lower, front, left-hand corner of the box and the upper, back, right-hand corner. Alternate junctions were either very close to or in contact with a heater strip. It was found by test that this arrangement could be easily duplicated, and it provided the necessary extremes of temperature. Readings were taken as often as necessary to follow the changes.

To have a complete record of the energy and power requirements, an ammeter, voltmeter, and wattmeter were connected into the circuit in addition to a kilowatt-hour meter. The moisture content was determined from samples taken at the beginning and end of each test. No significant difference was observed between the "before" and "after" values.

Figs. 3, 4, and 5 give some of the experimental results. The tests were conducted in a room temperature of 70-75 F.

DISCUSSION

To keep the maximum temperatures of the various portions of the soil during the heating period within satisfactory bounds, moisture content of the soil cannot be too low. This is amply stressed by an inspection and comparison of Figs. 3 and 4. Actually it is convenient to have the moisture content of the soil such that it is ready for use.

Having the box insulated not only gives a better temperature distribution, but it also reduces the operating cost. The efficiency depends upon several factors: (1) amount of insulation, (2) shape of the box, (3) time that the heaters are on, (4) temperature of the room, and (5) average soil temperature. For this box as compared with a 1-in pine box of the same shape, the saving was about 0.15 kw-hr per cu ft per 90 F temperature rise.

Considerable use of the pasteurizer demonstrated that the general design was such as to make it practical, convenient, sturdy, and efficient.

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[1]A. G. Newhall, "Experiments with New Electric Devices for Pasteurizing Soil", Bulletin 731, April 1940, New York (Cornell) Agricultural Experiment Station.

[2]A. G. Newhall and M. W. Nixon, "Disinfesting Soils by Electric Pasteurization", Bulletin 636, July 1935, New York (Cornell) Agricultural Experiment Station.
(The above references contain bibliographies of the early work in this field as well as reviews of all the present methods.)

[3]S. R. Cruz, "The Constant Current Resistance Soil Pasteurizer", published in this issue of AGRICULTURAL ENGINEERING.

[4]L. B. Carney, "Electric Soil Sterilization", AGRICULTURAL ENGINEERING for April 1932 (v. 13:95).

[5]I. P. Blauser, "Soil Sterilization by Electricity", AGRICULTURAL ENGINEERING for November 1935 (v. 16:436).

[6]L. S. Caple, "Belt Type Continuous Soil Sterilizer", Rural Electrification Exchange, Vol. 3, No. 2, (1940).

Distribution of Corn Yields on Farm Terraces on the Shelby Soil

(Continued from page 126)

The average yield of corn for the entire interval was 28.5 bu per acre and the average depth of surface soil is 0.84 ft. Referring to the graph representing the relation of surface soil depth to yield, it is found that an average yield of 31.2 bu per acre could be expected if the surface soil were distributed uniformly over the entire interval. This is, of course, assuming that the surface soil would have been held in place and its fertility maintained under the present cropping system without the support of terraces. Other studies[3,4] at the station indicate that neither the soil nor the fertility would be maintained on this field without this support.

[3]Zingg, A. W. Degree and Length of Land Slope as It Affects Soil Loss in Run-off. AGRICULTURAL ENGINEERING, February 1940.

[4]Whitt, D. M. and Swanson, C. L. W. The Effect of Erosion on Chemical Changes Occurring in the Shelby Loam Profile. (To be published in the Journal of American Society of Agronomy.)

Constant-Current Resistance Soil Pasteurizer

By Santiago R. Cruz
JUNIOR MEMBER A.S.A.E.

GREENHOUSE and nursery operators now generally recognize that the pasteurization of soil increases the yield and vigor of the plants by the removal of bacteria, fungi, weed seeds, and insect eggs, and, when moist heat is used, by the release of plant food. In this paper only pasteurization by moist heat will be considered for which purpose a temperature of 65 to 70 C (degrees Centigrade) has been found to be amply sufficient.

Heat may be applied to the soil by either one of two methods, one of which we will designate the hot-pipe or indirect method, and the other the internal-resistance or direct-heating method. In the hot-pipe method the pipes are heated from within by electrical space heaters properly mounted on insulators. With this type of heater a major difficulty is the lack of uniformity of temperature throughout the soil mass with temperatures adjacent to the pipes possibly so high as to destroy valuable organic matter in the soil. This difficulty is minimized by increasing the moisture content of the soil, but this involves wasting power to heat the water and the soil becomes puddled and hard to handle.

Paper presented June 24, 1941, at the annual meeting of the American Society of Agricultural Engineers at Knoxville, Tenn. Author: Agricultural engineer, college of agriculture, University of the Philippines.

The internal-resistance method necessarily involves the use of electricity which flows throughout the entire soil mass and produces heat wherever it flows because of the resistance offered by the soil which thus itself becomes the heating element. Factors which influence the flow of current and consequently the temperature developed are: type of soil, its temperature, compactness, the moisture content of the main body of soil, and the moisture content of that directly in contact with the electrodes through which the current enters and leaves the soil.

Transformers for supplying electric power are of two main types, the usual kind supplying variable current at constant voltage, and the less usual street lighting kind normally supplying a certain fixed rate of current at whatever voltage is required to force that constant current through the lamp resistance encountered. In soil heating, the rise of temperature during heating automatically reduces the resistance of the soil. If a constant-voltage transformer is being used, then with this decrease of resistance the current will rise to be stopped, possibly, only by the blowing of fuses or the burning out of the transformer, while, at the same time the soil may be injuriously overheated. Contrastingly, if a constant-current transformer delivers current

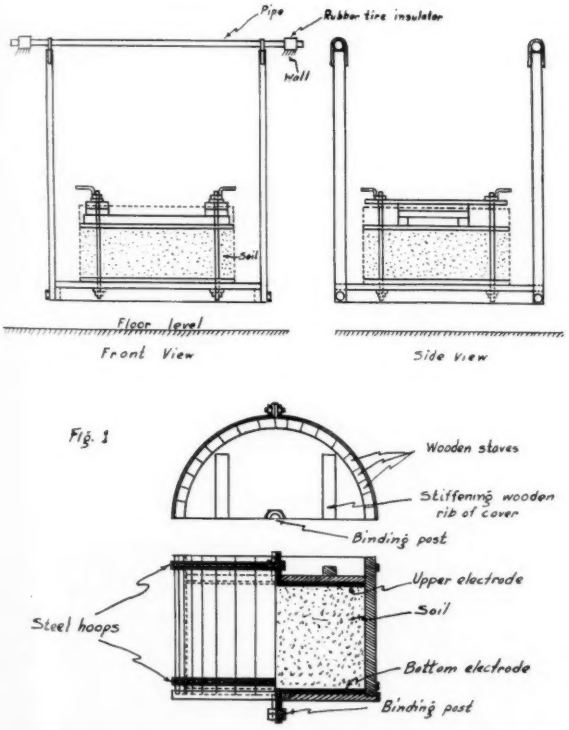
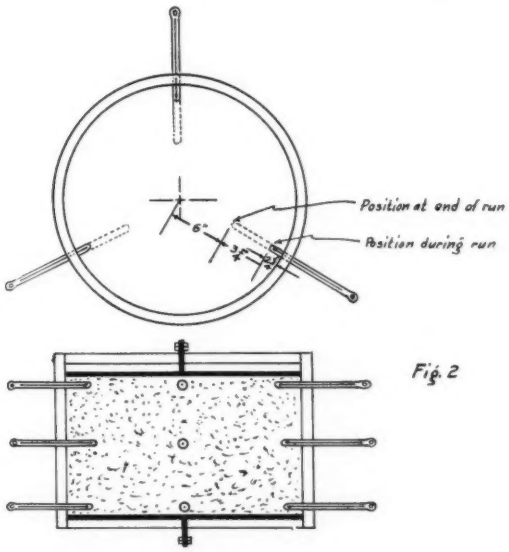
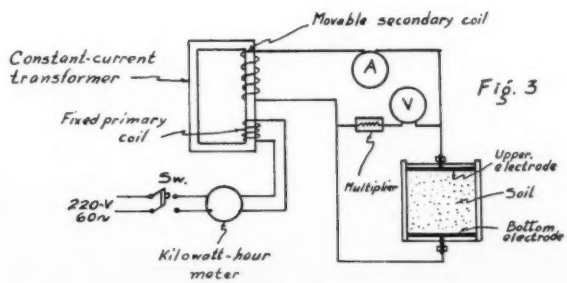


Fig. 1 Top sketch shows two views of assembly of supporting platform for sterilizer; outline of latter shown by broken line. Bottom sketch shows details of sterilizer proper • Fig. 2 This sketch shows positions of nine thermometers • Fig. 3 Wiring diagram showing connections of various apparatus





to a decreasing soil resistance, the current will first reach a certain predetermined maximum, and thereafter, as the resistance decreases, the voltage will automatically decrease at such rate as will prevent the setting up of more than the prescribed maximum current.

Let us consider specifically the operation of these two types of transformers in heating soil with high resistance such as sand as compared with soil of low resistance such as moist loam. On sand limited constant voltage is insufficient to develop current sufficient to heat it to pasteurizing temperature, unless moisture or salts are added, while with variable voltage the voltage will rise to a point sufficient to force the current through. On wet soil of low resistance constant voltage will send through destructively high currents, while variable voltage will drop as soon as the rated current is reached: constant voltage will waste energy and may wreck itself on useless water, while variable voltage will automatically refuse to try to heat soil that is needlessly wet.

In answer to the suggestion that very high variable voltage would be prohibitively dangerous, it can be stated that the author at first provided himself with protective rubber gloves, but in practice did not use them as a voltage investigation on a variable voltage pasteurizer showed that there was actually no such danger. Since the secondary winding of the constant-current, series-lighting transformers need not be grounded, a shock can occur only if one of the electrodes and a wet portion of the pasteurizer are touched. No shock can occur even if one electrode and the wet floor or a dry portion of the pasteurizer are touched. In normal operation such a pasteurizer is practically dry, and if the electrodes are incased in some sort of insulating cap danger from shock would not be present.

Long consideration of the advantages of variable voltage constant-current power supply for soil pasteurizing led the author to undertake a test of its use for this purpose as a thesis problem for a master's degree at Cornell University. There was secured a 220-volt, 60-cycle, constant-current transformer with counterbalanced movable secondary winding having a maximum output current rating of 6.35 amp, maximum voltage of approximately 440 v, and maximum power rating of 2 kw. Experience showed that it was most efficient when the soil resistance was about 50 ohms. In Figs. 1, 2, and 3 are shown the insulating supports for the pasteurizer, the details of its construction, the locations of thermometers, and the electrical connections. The pasteurizer was a miniature wooden silo 2 ft in diameter and 20 in high; at top and bottom were parallel horizontal electrodes of 20-gage galvanized iron sheet, the top one being under a ribbed cover arranged to be tightened down onto the soil by four bolts.

As time does not permit a description of the manner of conducting the tests or a discussion of the great mass of data secured, the general results and conclusions are summarized as follows:

1 Pasteurizing soil by electricity in a resistance type sterilizer connected to a variable-voltage, constant-current transformer proved to be very practical.

2 The resistance type pasteurizer with variable-voltage supply is simple, inexpensive to build and very easily operated.

3 It was found possible to pasteurize sandy loam with a moisture content as low as 6.08 per cent, sand at 6.45 per cent (without electrolyte), and muck at 44.4 per cent.

4 Due to the decrease in moisture content, the kilowatt-hours per cubic foot necessary to raise the temperature of the soil 50 C were reduced very markedly as compared to those reported by many other workers—0.72 for sandy loam, 0.808 for sand, and 0.705 for muck.

5 The power demand was variable, but the maximum did not exceed 2 kw the rating of the transformer.

6 Danger from shock was found to be negligible; in any case the pasteurizer is as safe, if not safer, than ordinary household circuits.

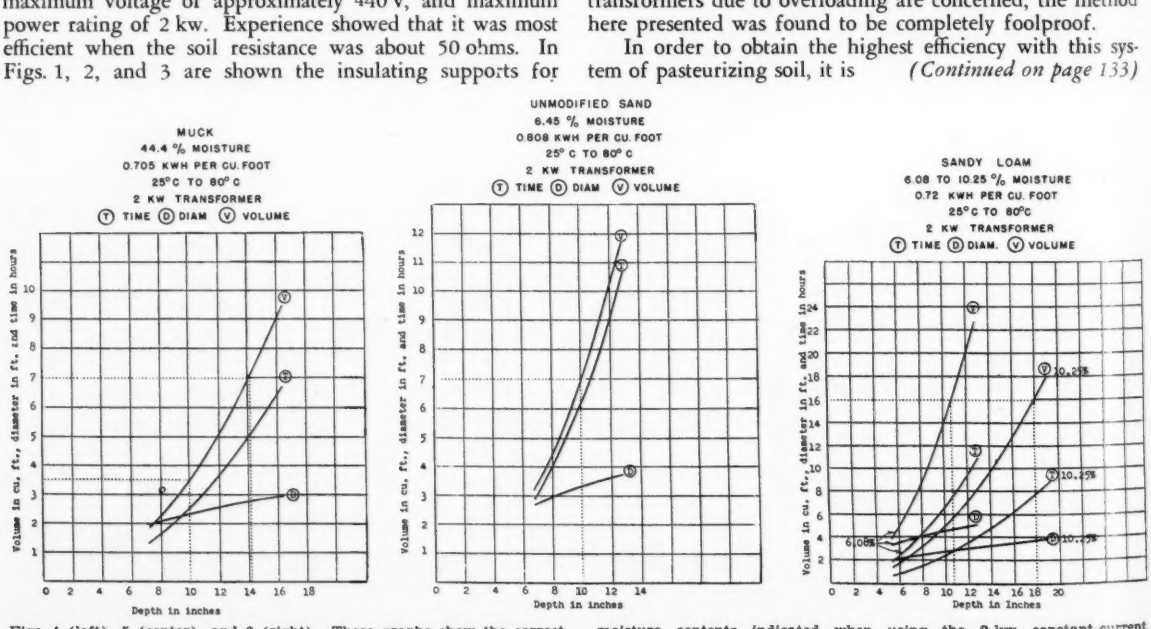
7 The mechanical condition of the soil pasteurized at low moisture content was much improved and handling was facilitated.

8 Drying up of the electrode contacts at low moisture contents was effectively prevented by placing a thin layer of comparatively wet soil immediately in contact with the electrodes.

9 Temperature distribution was not exactly uniform but vastly superior to that of the hot pipe pasteurizers.

10 As far as blowing out of fuses and burning out of transformers due to overloading are concerned, the method here presented was found to be completely foolproof.

In order to obtain the highest efficiency with this system of pasteurizing soil, it is *(Continued on page 133)*


MUCK
44.4 % MOISTURE
0.705 KWH PER CU. FOOT
25° C TO 80° C
2 KW TRANSFORMER
T TIME D DIAM V VOLUME
Volume in cu. ft., diameter in ft. and time in hours
Depth in inches
UNMODIFIED SAND
6.45 % MOISTURE
0.808 KWH PER CU. FOOT
25° C TO 80° C
2 KW TRANSFORMER
T TIME D DIAM V VOLUME
Volume in cu. ft., diameter in ft. and time in hours
Depth in inches
SANDY LOAM
6.08 TO 10.25 % MOISTURE
0.72 KWH PER CU. FOOT
25° C TO 80° C
2 KW TRANSFORMER
T TIME D DIAM. V VOLUME
Volume in cu. ft., diameter in ft. and time in hours
10.25%
10.25%
10.25%
6.08%
Depth in inches

Figs. 4 (left), 5 (center), and 6 (right). These graphs show the correct relationships between time, soil depths, and pasteurizer electrode diameters in order to secure the highest efficiency for the soils and moisture contents indicated when using the 2-kw constant-current transformer used in the Cornell tests and reported in the accompanying paper by Mr. Cruz

Field Shelling of Corn

By R. F. Skelton and H. P. Bateman

JUNIOR MEMBER A.S.A.E. MEMBER A.S.A.E.

WHEN wages are high and labor is difficult to obtain, there is an increased need for labor-saving machinery and a greater demand for more economical production. A picker-sheller, combining the operations of picking and shelling, shows promise of reducing the man-labor required in harvesting the corn crop.

Corn occupied the largest acreage of any field crop in the United States in 1940. The total was 86,449,000 acres, or 26 per cent of the total area of crop land harvested[2]*. About 90 per cent of the corn crop is harvested for use as grain and a major part is shelled before being used. Probably less than 15 per cent was husked by machines in 1938[5]. Only 50 per cent of the 1940 Illinois corn crop was harvested with mechanical pickers[3]. This indicates that the possible saving in labor through the use of mechanical pickers has not greatly reduced the total labor required to harvest the corn crop. Methods which influence the harvesting of corn as grain will, therefore, largely affect the amount of labor required to harvest the total corn crop.

Labor, Power, Fuel Requirements, and Capacity Tests. The first objective in the study of a new method should be to determine its economic advantage as compared to that of methods in common use in a given area. Through the cooperation of the owner of a picker-sheller it was possible to obtain fuel, time, labor, and capacity records, making it possible to calculate harvesting cost for this new method, and to compare it with methods in common use.

The picker-sheller used was a two-row, pull type, rubber-tired Case machine equipped with a cylinder sheller and cleaner instead of the regular husking unit, and a 40-bu overhead grain tank. A 1936 model low-compression, Allis-Chalmers W-C rubber-tired tractor was used to operate the picker-sheller. Regular gasoline was used. The low gear speed of approximately 3 mph was used throughout the season. This tractor is smaller than would normally pull a two-row corn picker.

The crew consisted of two men, one operating the tractor and picker-sheller and the other hauling grain from the field in a truck. A Servis-recorder was used to determine the total time of operation and the lost time during each day. Fuel was measured with a depth gage to determine the amount of fuel used each day in each field. All fields were measured to determine the area harvested. Since all the grain was delivered to the elevator, an accurate record of the bushels harvested was obtained.

The results of these tests in 14 different fields showed that 10,001 bu of corn were harvested with the picker-sheller, from 291 acres during 29 working days from October 21 to December 10, 1940. This is approximately the maximum acreage that could be harvested in one season because the equipment was operated every day suitable for harvesting. Of the 215 field hours required to harvest the corn, 144 hr, or 67 per cent, was spent in picking and in turning on the ends. Of the remaining time 43 hr were required to unload the corn and to make minor adjustments, 20 hr to service the machine, and 8 hr to make repairs due to breakdowns.

The performance record of the first season's use of the picker-sheller is shown in Table 1. The yield per acre did not influence either the time and fuel required per acre or the capacity in terms of acres harvested per hour, because the tractor was operated at approximately the same speed in all fields. However, as the yield increased, less time and fuel were required per bushel, and the capacity in bushels per hour increased. The fuel per hour includes the amount used under load and idling. Idling time ranged from 13.2 to 25.3 per cent, with an average of 19.6 per cent for the season.

TABLE 1. RATES OF PERFORMANCE OF CORN PICKER-SHELLER IN 10 FIELDS

Field No.	Yield per acre, bu	Field size, acres	Fuel used* Per hour, gal	Fuel used* Per acre, gal	Total field time per acre, hr	Capacity** per hour Acres	Capacity** per hour Bushels
13	24.2	58.1	1.82	1.16	.73	1.37	33.1
9	30.4	5.0	1.80	1.10	.71	1.42	40.0
10	30.4	20.1	1.65	1.11	.77	1.29	40.0
5	30.6	28.2	1.77	1.10	.71	1.41	43.1
6	36.4	25.6	1.94	1.09	.63	1.59	57.9
7	37.3	18.5	1.80	1.04	.66	1.51	56.2
12	39.9	15.1	1.73	1.16	.80	1.25	49.7
8	45.8	10.7	1.83	.96	.65	1.55	70.8
14	46.5	24.5	1.95	1.16	.70	1.43	66.3
11	56.6	10.9	1.71	1.17	.75	1.33	75.1
Average	34.4		1.81	1.12	.74	1.35	46.5

*Based on time tractor engine was operating.
**Based on total field time.

Cost Comparison of Four Methods of Harvesting. On the basis of the data shown in Table 1 and the rates shown in Table 2, a cost comparison of hand husking and three mechanical methods of harvesting was made. The equipment and labor for harvesting, hauling, and shelling were selected on the basis of common practices followed by farmers in the area. Elevating and storage costs have been eliminated from the analysis in order that the harvesting methods might be compared directly. Each method includes only the operations necessary to process the corn on the farm, from the stalk to a shelled condition.

The machine cost per acre was calculated from the annual cost and the acres harvested per year. Annual

TABLE 2. RATES USED IN COST ESTIMATES OF VARIOUS METHODS OF HARVESTING CORN

Operation	Hand husking	1-row picker	2-row picker	2-row picker-sheller
Harvesting				
Labor cost, dollars	.05/bu*	.40/hr	.40/hr	.40/hr
Labor per acre, hr**	5.6	1.2	0.8	0.74
Machine first cost, dollars		500	750	940
Machine life, acres		1000	1600	1600
Tractor cost per hour, dollars		.48	.55	.48
Hauling to crib				
Labor cost per hour, dollars		.30	.30	
Truck and driver cost per bushel, dollars				.0075
Wagon cost per hour, dollars	.02	.04	.06	
Team cost per hour, dollars	.32	.32		
Tractor cost per hour, dollars			.40	
Shelling				
Stationary sheller cost per bushel, dollars	.01	.01	.01	

*Cash rate paid to husker in addition to room and board valued at $1.00 per day.
**Rates based on yield of 50 bu per acre.

Paper presented December 2, 1941, at the fall meeting of the American Society of Agricultural Engineers at Chicago, Ill. A contribution of the Power and Machinery Division. Authors: Staff members of the agricultural engineering department, University of Illinois.

*Superscript figures refer to the bibliography appended to this paper.

machine costs include overhead charges and depreciation. Overhead charges are comprised of interest, insurance, taxes, housing, and repairs, and are charged at a constant rate per year, regardless of acres harvested, or 6.15 per cent of the original investment of the one-row picker, and due to higher repair costs, at 6.65 per cent for the two-row picker and the two-row picker-sheller. Annual depreciation was based upon the original investment and the length of life of each machine. Length of life in years was calculated from the estimated life in acres and the acreage harvested annually; however, the maximum life was limited to fifteen years. The other items of harvesting and shelling costs were charged at a constant rate per hour or bushel.

The cost of each method for varying acreages is shown graphically in Fig. 1. It is interesting to note that the cost per acre for hand husking was constant regardless of the acreage harvested, while with machine methods the cost per acre decreased as the acreage harvested per year increased. This decrease was due to distributing the annual overhead costs of the machines over greater acreages while other costs such as the tractor charge per acre were assumed constant for all acreages. The intersections of the curves suggest critical acreages at which the methods of harvesting might be changed to obtain more economical production.

The picker-sheller method of harvesting shows a lower unit cost than other methods for areas above 45 acres. This advantage can be attributed to the saving in shelling expense, decreased field time, smaller power requirement, and decreased hauling costs.

Mechanical Performance. The mechanical performance of the picker-sheller was investigated by a series of loss tests conducted under varied crop and field conditions. Thirteen tests were made on areas two rows wide and of a length to give an area of 1/56 acre. The conditions of the plot and crop were recorded by noting such factors as row and hill spacing, number of standing and lodged stalks, number of ears on ground and on stalks, and other factors which might influence the losses.

Samples were collected from the plot, cob rack, and grain tank in such a manner that the picking losses, shelling losses, yield, and condition of the grain could be determined. Picking loss consisted of ears lost and corn shelled by the snapping rolls. Shelling loss consisted of corn remaining on the cobs and shelled corn which was lost among the cobs from the cleaning sieve.

A summary of the loss tests made under various field and crop conditions is given in Table 3. The first four tests in drilled corn, with yields ranging from 23 to 66 bu per acre, show no correlation between yield and loss in bushels per acre. Tests 5 and 6 on hybrid and open-pollinated white corn, check planted, show no significant

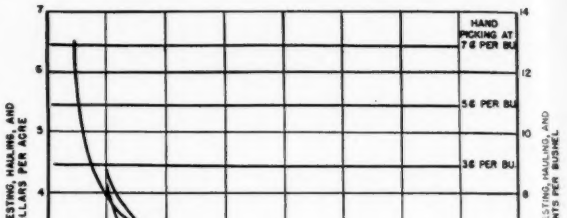


Fig. 1 Cost comparison of corn harvesting methods

difference in losses. Tests 7, 8, 9, and 10 were in check planted yellow hybrid corn which was standing well and in ideal condition for harvesting. The results of Tests 7 and 8 taken at different locations in the field show losses similar to those in previous tests. A comparison of Test 8 with Tests 9 and 10, all at the same location in the field, indicates that an increase in speed effects a reduction in loss, resulting from a reduction in the number of ears dropped by the gathering points. Approximately one-half the stalks in Test 11 were lodged at right angles to the direction of machine travel, and caused the maximum loss. Soft corn of light test weight and high moisture content encountered in Tests 12 and 13 accounts for the increase in corn left on the cobs. Eighty-seven per cent of the total average loss occurred in picking, and the remaining 13 per cent occurred in shelling.

Marketing and Storage of Field Shelled Corn. During the average fall season the relative humidity is too high to allow standing corn to dry to 14 per cent[4], which is recognized as the maximum moisture content for safe storage of shelled corn as it is now stored; consequently, the corn harvested by the picker-sheller was hauled directly to local elevators where it was mixed with dry corn. All of the grain from the sheller was sold as No. 4 market grade with the exception of two fields, one of which sold as No. 3, and the other was soft corn which sold as sample grade. With the exception of soft corn, no attempt was made to harvest any field until the moisture content was low enough to meet the No. 4 market requirement, or 20 per cent[1]. The corn moisture percentages reported are greater than the percentages which determined the grade, because there was some reduction in moisture before the

TABLE 3. SUMMARY OF LOSS TEST RESULTS

Test No.*	Field No. and location	Speed, mph	CROP CONDITION: Moisture Grain, per cent	Moisture Cobs, per cent	Cobs and husks, per acre, lb	YIELD PER ACRE: Available, bu**	Harvested, bu	GRAIN LOSSES PER ACRE: Picking Ears, bu	Picking Shelled, bu	Shelling On cobs, bu	Shelling Off cobs, bu	Total, bu
1	5a	2.75	20.4	33.1	704	62.47	60.11	1.92	0.24	0.10	0.10	2.36
2	5a	2.81	21.2	38.9	1087	65.86	63.19	1.70	0.48	.25	.24	2.67
3	5b	2.87	19.3	36.2	584	27.80	25.19	2.06	0.28	.10	.17	2.61
4	5b	2.77	20.3	29.1	477	23.36	20.64	2.14	0.30	.11	.17	2.72
5	6a	3.01	17.3	23.4	482	27.77	25.88	1.38	0.39	.06	.06	1.89
6	6b	3.06	19.0	24.2	635	34.55	32.54	1.55	0.35	.06	.05	2.01
7	7a	3.12	17.2	24.6	708	51.09	48.42	1.49	0.95	.05	.18	2.67
8	7b	3.08	19.7	31.6	603	43.00	40.73	1.44	0.65	.03	.15	2.27
9	7b	3.93	19.9	32.2	575	42.96	41.79	0.0	1.09	.01	.07	1.17
10	7b	3.83	19.0	37.2	657	44.12	43.00	0.29	0.76	.00	.07	1.12
11	12	2.90	18.3	27.6	679	47.67	41.30	5.08	1.10	.12	.07	6.37
12	13a	2.98	24.7	24.7	674	35.91	33.72	0.74	0.62	.71	.12	2.19
13	13b	2.87	23.2	25.2	778	42.87	40.83	0.11	0.91	.95	.07	2.04
Average								1.53	0.63	0.20	0.12	2.48
Per cent of total average loss								61.6	25.4	8.1	4.9	100.0

*Drilled corn, Tests 1, 2, 3, 4; checkrowed corn, Tests 5 through 13; hybrid white corn, Tests 1, 2, 3, 4, 5; open-pollinated white corn, Test 6; hybrid yellow corn, Tests 7 through 13; per cent ears touching ground due to lodging, less than 2.5 per cent, Tests 1, 2, 4, 8, 9; 2.5 - 7.5 per cent, Tests 7, 10, 13; 7.5 - 15 per cent, Tests 6, 12; 19 per cent, Test 5, and 43 per cent, Test 11.

**Yield available to machine, harvested corn plus machine losses.

elevator samples were obtained. The reduced return from the sale of lower grade field-shelled corn tends to offset the lower cost of harvesting.

Grade samples obtained during the loss tests revealed that moisture content was the factor which determined the grade. The amount of damage and foreign material which could be attributed to the machine was well within the limits allowed for No. 1 corn. The mechanical operation of the machine did not alter the grade.

The wider adoption of the field shelling method of harvesting depends in part upon the adaptation of storage structures in which high moisture corn can be dried and stored on the farm.

Soil Pasteurizer

(Continued from page 130)

necessary that there shall be the correct relationship between the type of soil, its moisture content, the diameter of pasteurizer, the soil depth, and the performance characteristics of the particular transformer in question. If the transformer characteristics are known, it is possible to determine by computation from the data secured in this investigation all the necessary facts. This has been done for the 2-kw transformer for muck at 44.4 per cent moisture, sand at 6.45 per cent moisture that has not been treated with any salt or other electrolyte, and for sandy loam at two moisture contents, 6.08 and 10.25 per cent. The results are set forth in the accompanying graphs (Figs. 4, 5, and 6).

Referring to the graph for muck (Fig. 4) at 44.4 per cent moisture, in order to get an efficiency of 0.705 kwh per cu ft in heating from 25 to 80 C it is seen that, if a volume of $3\frac{1}{2}$ cu ft is to be treated, the depth should be 10 in and the diameter $2\frac{1}{3}$ ft, in which case the time required for a 55 C rise will be about $2\frac{1}{2}$ hr. For a volume of 7 cu ft the depth should be 14 in, the diameter $2\frac{3}{4}$ ft, and the time will be 5 hr.

For unmodified sand (Fig. 5) at 6.45 per cent moisture, in order to get an efficiency of 0.808 kwh per cu ft it is seen that for a volume of 7 cu ft the depth should be 10 in, the diameter $3\frac{1}{4}$ ft, and the time for a 55 C rise will be a little over 6 hr.

The graph for sandy loam (Fig. 6) gives information for two different moisture contents, 6.08 per cent and 10.25 per cent, which we will call 6 and 10 per cent. For a volume of charge of 16 cu ft for maximum efficiency, the depth should be 11 in for 6 per cent and 18 in for 10 per cent; the diameter would be nearly 5 ft for 6 per cent and nearly 4 ft for 10 per cent; the time in each case would be approximately 8 hr. The amount of energy required would be in each case the same because the rate per cubic foot is specified at the outset as being identical for all conditions indicated on the graph.

It is repeated that these figures are for a small 2-kw transformer like the one used in the tests. Larger units of 5, 10, or 15-kw capacity can be used and equally specific data worked out if the transformer performance characteristics are known. With a 15-kw transformer for soils of the moisture contents specified above there could be pasteurized at one treatment a maximum of 80 cu feet of sand, or 90 cu ft of either muck or sandy loam.

The objection has been raised to the whole question of the use of series street lighting variable-voltage, constant-current transformers for soil pasteurizing that these transformers are expensive and not generally available. The reply to this is that this investigation was undertaken to show by demonstration the practicability and operating simplicity and economy of the system which the author's analysis of the problem had made clear to him before the work was begun. These objectives have been attained. It has been proved that this plan is practical, effective, simple in operation, economical of power, and as safe or safer than ordinary house wiring systems. The facts are here for the consideration of others; time will show whether the intrinsic merits of this method are adequate to bring it into commercial use.

SUMMARY

1 The lower cost of the field shelling method as compared to present methods for areas greater than 45 acres, results from combining the picking and shelling operations, reduced hauling costs, greater capacity of the machine, and a smaller power requirement.

2 The greatest portion of the harvesting losses in fields yielding up to 66 bu per acre was caused by the snapping rolls and gathering points.

3 The high moisture content of field corn during the harvest season and the lack of satisfactory storage or drying facilities at present, necessitates that field-shelled corn be sold from the field at a low market grade.

4 Foreign material and damage caused by the operation of the machine did not result in a reduction of market grade.

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Discussion by Martin Ronning

MEMBER A.S.A.E.
Chief engineer, power machinery division, Minneapolis-Moline Power Implement Co.

IN our company, we have not made a detailed study of the problem of shelling corn in the field because we have believed this method to be rather impractical due to the uncertain weather conditions during corn harvest, resulting in a serious problem of storage of the shelled corn. However, I do not think this method is hopeless and not deserving of study. It must be remembered that at one time there was a doubt as to the practicability of the combine for use in the Middle West; in fact, there are some communities where the farmers still feel that way about it.

From the standpoint of the machinery designer, the field shelling of corn is not particularly difficult. The job can be done either with a modified combine or by a corn picker with a corn shelling attachment. The main problem, as I see it, is that of taking the corn from the field with a moisture content safe for binning, which should not exceed 14 per cent.

In general, corn matures sufficiently for harvesting with a corn picker, in the corn belt proper, from October 15th to 30th. The moisture content then is about 20 per cent, and it requires several weeks more of good weather to bring it down to a safe moisture content for bin storage. On the average the farmer needs to take advantage of all the good weather from the *(Continued on page 137)*

Results of a Drilled Corn Experiment

By Lester J. Pfister
ASSOCIATE A.S.A.E.

AT THE suggestion of one of the farm equipment companies we conducted an experiment for the purpose of checking the possibilities of low cost corn production under actual farm conditions, during the crop seasons of 1939, 1940, and 1941. Another company also assisted us by furnishing equipment for the harvest.

Cost comparisons made in connection with this study include only the costs involving soil preparation, planting, and cultivation. The study included drilling corn with close row spacing, with fields of standard 40-in checkrow spacing used as checks. The drilled fields were planted with a special 8-row planter made up of four used planters; the machine as a unit drilled 8 rows at a time (spaced 20 in in 1939) with kernels dropped about 12 in apart in the row. This spacing was found to be too close for practical harvesting, and it was increased to 22 in with the kernels dropped approximately 18 in in the row, in 1940 and 1941.

The purpose of the experiment was to compare production costs using the standard method in checkrowed fields with gasoline-powered tractor equipment and regular shovel cultivation, with the drill method. In the drilled field all field work, except harvesting, was done with a diesel tractor, and there was no cultivation with a shovel cultivator. Furrow openers were used in the 1939 season; however, under the level field conditions which existed, there seemed to be no advantage in this method, and it was discontinued in 1940 and 1941.

As a part of the intended plan for low cost production, fall plowing was practiced in all cases. Field cultivators were used in the case of drilled corn in place of the regular disk harrow. In the season of 1939, planting was delayed until June 1, the intention being to destroy several weed crops. The checkrowed corn was planted at customary planting time, about two weeks earlier than the drilled field. This same practice was followed in 1940. However, it was observed that during the 1939 and 1940 seasons failure of weeds to start as early as had been anticipated, indicated that planting in the drilled field may well be at the same time as regular planting, and in 1941 the field was planted May 14, at the same time as the cultivated fields.

The checkrowed corn in all cases was cultivated three times in addition to harrowing once following planting and the use of a rotary hoe before the first cultivation. The drilled fields in all cases were harrowed following planting, cultivated twice with a rotary hoe and twice with a finger weeder. The machine used was a springtooth type weeder, 26 ft in width. During all three seasons, there was no practical difference in freedom from weeds at the end of the growing season, comparing the two methods of cultivation.

During both harvest seasons a regular two-row picker was used to harvest the checkrowed corn. It was estimated that this picker left about 5 bu per acre of shelled corn and missed ears in the field which, in our observation, is about average for mechanical two-row mounted pickers.

The drilled field was harvested with a specially constructed combine, whereby a two-row snapping unit was attached to the combine in place of the customary combine header, and resulted in an entirely satisfactory job of harvesting the corn, the field loss being about 1 bu per acre. It is this difference in the efficiency of the harvesting equipment which is accountable for part of the increased yield shown in the accompanying table.

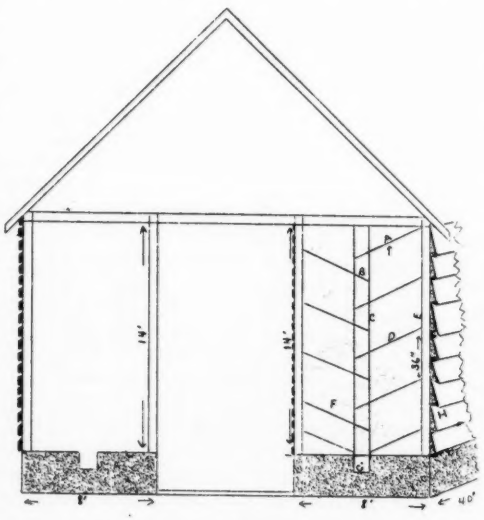
COMPARATIVE CORN PRODUCTION COSTS
(1939, 1940, and 1941 Averages)

Operation	Checkrowed Field No. Operations	Checkrowed Field Amount	Drilled Field No. Operations	Drilled Field Amount
Fall plowing	1	$ 61.28	1	$ 65.28
Disking		$ 38.11		
Field cultivation				$ 43.20
Harrowing	2	$ 11.33		$ 23.04
Planting	1	$ 14.42	1	$ 13.44
Rotary hoe		$ 7.21		$ 9.60
Weeder	1	$ 4.12		$ 18.24
Cultivation	3	$ 77.25		
Total		$213.72		$172.80
Average acreage		51.5		96
Cost per acre		$ 4.15		$ 1.80
Yield per acre, bu		67.02		93.7
Cost per bushel		$ .062		.019
Rainfall (Apr 1-Nov 1), in		16.76		16.76

It is concluded that higher yields resulted each year from the closer row spacing. The ideal spacing appears to be about 20 in apart in each direction. Three factors combine in making the difference in yield, namely, (1) thicker stand, (2) lack of disturbance of the root system by cultivation, and (3) greater efficiency in harvesting. Since these factors are variable and at the same time inseparable, it is impossible to tell the true significance of each.

As a practical method of commercial corn production, it is found to be satisfactory if special harvesting equipment is provided, and if storage space for the corn is in the form of a shelled corn ventilated storage crib, where storage on the farm is desired.

Naturally the storing of shelled corn with a relatively high percentage of moisture required a specially constructed storage. A standard crib was remodeled for this purpose in the form of sloping trays, whereby corn fed in from the top would seek its level on the trays.



End view of standard crib for ear corn remodeled by Mr. Pfister for the storage and natural drying of shelled corn. A, end view of shelf running full length of crib; B, inner ends of shelves overlap one foot; C, supports for inner ends of shelves; D, pitch of shelves, 1 in per foot; E, shelf spacing, 36 in; F, position of shelled corn; G, reversed end auger conveyor; H, 18-in siding

Paper presented December 2, 1941, at the fall meeting of the American Society of Agricultural Engineers at Chicago, Ill. A contribution of the Power and Machinery Division. Author: Owner, Pfister Hybrid Corn Co.

A Homemade Castor Bean Thresher

By Henry P. Clay

THE plant industry department of the Texas Technological College at Lubbock has been investigating the practicability of castor beans as a profitable crop for this region since 1938. To make this work possible a castor bean thresher has been developed to the stage described in this article. The threshing of the past season's crop of about 4,000 lb was recently completed.

The threshing device shown in the accompanying illustration, consists of an old truck tire mounted on a front wheel and spindle. This tire turns inside a piece of tractor casing with adjustable clearance provided. The threshing is done between the inside of the piece of tractor casing and the outside of the truck tire. After being rubbed out between the tires, beans and chaff drop through an air blast which separates the chaff from the beans. The beans are then divided into two streams and dropped on to the two separating rollers where the threshed beans are separated from the unthreshed beans. The separation of the threshed and unthreshed beans is accomplished by the separating rollers carrying the rough unthreshed beans over the top, while the smooth clean beans travel off the end of the roller. The unthreshed beans are rerun through the thresher.

When first built two years ago the machine had only one separating roller and used a vacuum cleaner motor and fan for air blast. It did good work and was used to thresh over 250 samples of beans, but was rebuilt to increase the capacity. No data were gathered on the capacity of the first machine, but the present machine threshed 37 lb of clusters in 10 min. This time did not include repassing of unthreshed beans. One hundred pounds of threshed beans per hour is about the capacity of the present machine. The limit in capacity is in the separating rollers. The tire has 50 to 100 per cent more threshing capacity than the separating rollers.

Analysis of clean beans collected from the rollers revealed the following:

Beans with cracked seed coat	.4	per cent
Beans not hulled (i.e., not removed by separating rollers)	.45	" "
Free hulls and foreign material, less than	.1	" "
Perfect beans	99.05	" "
	100.00	" "

Rerunning of the beans carried over by the separating rollers did not crack an appreciable number of seed coats as might be expected. A sample of such beans threshed and cleaned by the machine analyzed over 99.5 per cent by weight of clean uncracked beans.

One representative sack of clusters weighed and threshed showed the following results:

Weight of clusters	37.5 lb
Weight of stems removed by man feeding machine	1.0 "
Weight of clean beans recovered on first pass	17.6 "
Weight of clean beans recovered by repassing	8.7 "
Weight of all clean beans recovered	26.3 "
Weight of stems, chaff, immature, and cracked beans (37.5 – 26.3)	11.2 "

A check was not made to determine how many beans were crushed and blown out with chaff, but visual inspection showed this loss to be very small, probably less than 0.5 per cent. This, however, is controlled by the speed and clearance of the tire. It is also affected by the maturity and variety of beans being threshed.

Specifications for the construction of this homemade castor bean thresher are as follows:

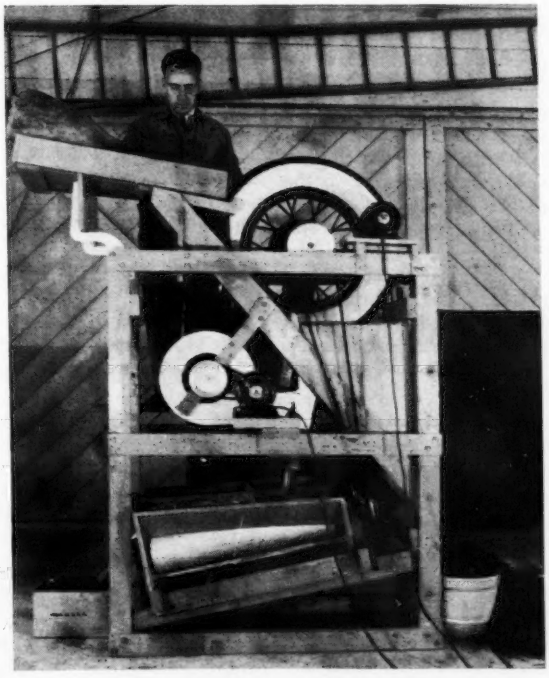
Threshing "Cylinder". 32x6.00 10-ply tire slightly inflated; speed, 50 to 100 rpm (80 to 90 rpm best); to be driven by ⅓-hp motor through rubber friction roller. Threshes whole clusters satisfactorily, but stems stop up cleaner as now designed.

Threshing "Concave". Approximately one-fifth of a 9.00x36 tractor tire, with bead cut off, mounted on a wood frame.

Fan. Four wood blades, 12x3½ in; spiders, 1x1x⅛ angle iron; 14 in diameter; speed, 850 rpm. Has damper in outlet. Mounted on ⅝-in CR steel shaft in maple bearings. Driven by ⅓-hp motor which has surplus of power. Could be driven conveniently by tire-drive motor if it were ½ hp and double shaft.

Separating Rollers. Two in number, made of white pine 7.5 in diameter, 30 in long on ⅝-in shaft in maple bearings; turns at 90 to 130 rpm; driven by ⅜-in rope belt from pulley on wheel carrying truck tire. Originally covered with burlap, but work well uncovered. Axis of roller at angle of 25 deg from horizontal. Parabola board which forms trough with side of roller, set at angle of 50 deg from horizontal and contact roller 3½ in below its top at upper end and ½ in below its top at lower end. Smaller rollers have not been tested.

We have reports of considerable work having been done with a rubber-bar cylinder combine and a peanut huller with special perforated cylinder for threshing castor beans. A hand-crank peanut huller was tested here with no success.



A homemade castor bean thresher

Article specially prepared for AGRICULTURAL ENGINEERING. Author: Assistant professor of agricultural engineering, Texas Technological College.

Controlling Erosion in Farm Drainageways

THE TERM "drainageways" refers to channels of surface drainage in the upper reaches of watersheds of upland or rolling terrain where slopes are steep enough to cause channel erosion. It does not include surface drainage or underdrainage of flatlands where natural drainage is inadequate. Neither does it include terrace outlets which are more restricted types of drainageways provided to receive and convey the discharge from the ends of terraces.

The first and most conspicuous evidence of soil erosion is the destructive gullying of farm land in unprotected drainageways. Control of erosion in these drainageways, therefore, is of primary importance in the control of erosion on farm land.

The necessity for properly protected field drainageways has been considerably increased by the increased adoption of contour farming. Operations on the contour may concentrate increased amounts of run-off water at intercepting waterways. Because of the increasing popularity of strip cropping and other contour operations, considerably more attention must be given to the proper designing, establishment, and maintenance of field waterways than has been the common practice.

Seeding. Seeding of farm drainageways is successful only when a proper seedbed can be prepared. This requires in any case that the bank slopes be sufficiently flat, if necessary being graded in, and that the soil have sufficient fertility to produce a vigorous growth within a short time after seeding. In most cases in order that seeding be successful, it is necessary that the surface water be diverted from the channel temporarily to permit the vegetation to become established and prevent erosion of the loose soil of the seedbed. The most desirable time to undertake establishment of vegetation by seeding is at the time of seedbed preparation for small grain. At this time sufficient work may be done to plow in and shape the channel. A grass-legume mixture seems to be the best in the long run.

Mulching. Mulching with material such as manure, or chaff which contains a large amount of desirable seed or straw, seems to be one of the best methods of securing an adequate sod quickly. The mulch retains moisture in the topsoil, protects the soil from compaction and baking out, provides shade for the tender seedlings, and as it decomposes adds organic matter to the soil. Mulching should be evenly applied and limited to about ½ ton per acre in order not to choke out the growth of the seeding. The effectiveness of mulching is much improved if it is stabilized either by wire mesh or a light scattering of brush. The latter will oftentimes serve to keep livestock off the new seeding, as well as serving to hold the mulch in place.

Sodding. Sodding is advisable in cases where the slope is too steep for successful seeding or where the soil is too poor to secure the rapid growth of a seeding. The solid sodding of a drainageway is an expensive process, and quite often strips of sod laid perpendicular to the flow will be sufficient to supplement seeding on the remaining area. When so placed, care must be exercised that the sod strips are not undercut by erosion at the lower edges. A sure way of avoiding this is to space the strips at vertical intervals of 3 to 4 in. Sod strips, on steep areas over which considerable water will pass, need to be secured. Wire mesh staked down over the sod or pinning of the sod with wire loops pushed into the ground 6 to 12 in are effective means of holding sod in place.

Structures. The use of structures in farm drainageways is to be avoided when possible, as they interfere with field operations and are comparatively expensive. However, under certain conditions of channel, slope, and amount of water to be carried by the channel, structures may be necessary. When structures are necessary, permanent types should be used. A combination of structures and vegetative control can be used successfully sometimes by spacing the structures in such a way the slope between structures is sufficiently low to be controlled by vegetation.

Location, Size, and Shape. Natural drainageways may successfully carry the water from considerable areas if they are not previously eroded and have maintained a broad shallow cross section. Under these conditions protection can usually be obtained by establishment of seeding, oftentimes merely by leaving the necessary width of waterway unplowed when breaking up a meadow. When necessary to construct an artificially shaped channel, a shallow parabolic section is preferable. This shape has an advantage over the flat-bottomed type of channel, in that low flows are concentrated in the center of the channel and do not cause meandering with the accompanying deposition and erosion which often results in destroying the vegetation. In shaping waterways, an effort should be made to blend the shoulders into the land slope so that water will enter along the sides without concentration as well as at the heads. Of course the shape and size of a constructed channel should be based on the anticipated peak volume flow and reasonable limitation of velocities.

An important consideration in designing any channel is its possibility of maintenance. Whenever possible it should be constructed wide enough and flat enough that it can be mowed. Wherever possible sufficient width should be provided to allow for harvesting hay and sufficient depth to allow for silting as time goes on and yet have carrying capacity for the water. Contour cultivation is one means of assisting in the establishment and maintenance of sod waterways because of the reduced volume of surface run-off and silt deposition. Contour lines also assist in determining the desirable location, width, and depth of channel. It seems that when contours become too crooked for the operation of farm machinery, or the contour divergence exceeds 3 per cent for 25 ft or more, the need for a sod waterway or strip is indicated.

Soil. The ability of the soil to produce whatever vegetation is selected for a drainageway abundantly and without delay is probably as important a factor in prevention of erosion as such factors as slope, velocity, and volume. This ability to produce vegetation is a matter of soil fertility and should be a factor which will be included with engineering factors as a means of determining the procedure to be followed.

Limits of Use of Vegetation. The size of drainage area to be handled by a vegetative protected channel should be limited to an area producing a volume of run-off that can be safely handled below the critical velocity for the slope and cross section of the channel and the type of vegetation. The experience reported was confined largely to bluegrass

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A contribution (1940-41) of the A.S.A.E. Subcommittee on Erosion Control in Farm Drainageways (Committee on Soil Erosion Control)—C. C. Ricker (chairman), R. B. Hickok, E. G. Welch, J. A. Slipher.

sod. With this type of vegetation, designs for maximum velocities of 5 fps have been ordinarily quite satisfactory. There appears to be as much danger in design for too low a velocity as for too high a velocity, as failure of field channels is often due to sedimentation which results from velocities too low to move the eroded materials through the channel. Channels designed for 4 to 5 fps seem to be more or less self-maintaining as the higher velocities occur frequently enough to remove material deposited at the lower velocities. It is difficult to design vegetated channels of desirable proportions of cross section for slopes much greater than 15 per cent. The maximum quantity which can be safely carried on this slope is probably around 20 cfs. A 10 per cent slope on the same basis will safely carry about 30 sec-ft, a 5 per cent slope approximately 50 sec-ft, and up to 70 sec-ft for slopes of 2 per cent. Slopes too flat for thorough drainage will result in drowning out the desirable vegetation.

BLUEGRASS IS A MOST DESIRABLE VEGETATION TO PREVENT EROSION IN WATERWAYS

Types of Vegetation. Bluegrass is probably the most desirable vegetation for waterways in cultivated fields where it is adaptable, because it has a very dense root system which prevents erosion. While legumes and certain other grasses are effective in eventually establishing a bluegrass cover in the channel, they do not afford anything like the protection that is ultimately obtained with the bluegrass. There are, of course, certain conditions under which bluegrass is not satisfactory. Redtop is desirable in a seed mixture where soils are too wet for rapid establishment of bluegrass. Where extremely wet conditions obtain, reed canary grass is adaptable. Reed canary grass, however, like other heavier types of vegetation will substantially reduce the effective cross section of the channel, for which proper allowance must be made.

Methods of Establishing and Maintaining. Ordinarily vegetation can be established by seeding. The use of straw mulch and discarded woven-wire fencing has proved to be a very satisfactory aid in the establishment of vegetation at critical points. Sodding is considered impractical and expensive for the farmer, except for short, steep slopes such as flumes or overfalls. Mowing at proper times to control the growth of undesirable vegetation is an important part of the maintenance.

One of the most difficult problems in connection with waterway maintenance is to prevent encroachment on the channel with tillage machinery. It seems that practically no farmer has the proper conception of the size of channel which is necessary, and frequently too small channels have resulted in serious damage. In such cases, the flow is concentrated at the edges of the vegetation, and due to constriction of the channel is stepped up to erosive velocity. This often results in cutting two or more channels in place of one.

Considerable research work needs to be done on the control of erosion in farm drainageways, including the following phases:

1 Means of protection

2 Hydrologic and hydraulic design problems

3 Detailed study of the characteristics of various types of vegetation for use in channels. Limiting velocities, depths, etc., should be determined for more types of vegetation. Apparently, this work has been confined in the past to southern types of grasses.

4 Problems of how to get substantial waterways established and maintained on farms. This involves simplified methods of design, development of construction methods, and methods for practical maintenance, and education of farmers to a realization of the importance of the problem.

Field Shelling of Corn

(Continued from page 133)

latter part of October on to make sure of getting his crop in before winter sets in.

The agronomists have done such wonderful things in hybrid development in recent years, that it is possible they will develop hybrids that can be depended upon to mature to a safe binning moisture content earlier than the present hybrids, thus giving the farmer a safe margin of time to get his corn harvested under normal weather conditions.

It is also possible that something can be done in the way of bin ventilation to handle safely corn with a greater moisture content. Or possibly artificial drying may be resorted to, although the cost would probably be prohibitive.

It seems reasonable that before any sweeping change in farming procedure of any kind can come about, there must be a definite economic reason for so doing, and if there is coupled with this a definite relief from drudgery, as in the transition from the grain binder-thresher method to the combine, the evolution is bound to be quickly accomplished.

It does not seem, however, that a great saving would result from field shelling of corn, nor would there be much lessening of disagreeable labor involved. We must also bear in mind that the corn grower, who now owns a corn picker and who has a good corncrib on his farm, in which he can crib his corn with a feeling of safety, would not readily discard his picker for a field shelling machine and replace his corncrib with a bin for shelled corn.

From the Philippines

To the Editor:

I AM enjoying my work here as instructor in the department of agricultural engineering at the University of the Philippines, Laguna. Besides teaching agricultural engineering in the college of agriculture, I am doing a lot of research work. I have introduced the idea of soil sterilization by electricity in our agricultural experiment station, and at the present time three separate investigations along this line are going on here in different departments. I found out that soil infestation by pathogenic organisms is quite a problem here and that nothing was being done about it before I came. Crude methods were tried, but they were either unsuccessful or too laborious to be of practical value. I have introduced modern methods of statistical analysis of experimental data and at present I am conducting two classes in this course, one for professors and another for students.

I am at present adapting my electrolytic device (see AGRICULTURAL ENGINEERING June 1941, pages 211-214) as a laboratory rheostat. This work is almost finished and I have arrived at the conclusion that it is superior to the metallic rheostat in all important respects. My next work along this line is to adapt it as a water heater, milk sterilizer, and motor starter.

My most important research work, however, is in "balut-making," a local industry employing a crude but remarkable method of artificial incubation developed in the Philippines, which ranks with the ancient Egyptian and Chinese methods of artificial incubation. "Balut" is a partially incubated duck egg extensively used in the Philippines, and when boiled in water becomes a nutritious food for children and tubercular adults. It is rich in readily available calcium so much needed by children for bone building and by patients in combating the ravages of tuberculosis. It is my intention to conduct a scientific study of balut-making with the end in view of adapting my electrolytic incubator for improving the process. It has been shown that incubating eggs under high humidity conditions increases the calcium content of the embryo. The electrolytic incubator is especially adapted to this, as you will remember.

SANTIAGO R. CRUZ
College of Agriculture
University of the Philippines
Laguna, P. I.
November 21, 1941

NEWS

A.S.A.E. Officers for 1942-43

AS a result of the annual election of officers of the American Society of Agricultural Engineers conducted by letter ballot, the following duly elected officers will take office at the close of the annual meeting of the Society in June:

President, Harry B. Walker, head, agricultural engineering division, University of California.

Councilors (three-year term each), E. C. Easter, agricultural engineer, Alabama Power Company, and B. P. Hess, manager, rural electrification, Westinghouse Electric and Manufacturing Co.

The new Council of the Society for the year 1942-43 will include the above-named officers, together with E. E. Brackett and Geo. W. Kable, past-presidents; and E. A. Silver, E. G. McKibben, C. E. Frudden, and R. W. Carpenter, councilors.

The newly elected Nominating Committee of the Society will consist of D. G. Carter (chairman), A. P. Yerkes, and E. D. Anderson.

Davidson Elected to Swedish Academy

THE Royal Swedish Academy of Agriculture through its Secretary Thure Bjorkman, announces the election of Dr. J. Brownlee Davidson, head of the agricultural engineering department, Iowa State College, and first president of the American Society of Agricultural Engineers, as a foreign member of the Academy.

The certificate of membership which was voted December 5 last, reached Dr. Davidson just recently from Stockholm by air mail via Brazil, and came as a complete surprise to him. The membership was granted "for eminent work in the field of agricultural science."

British Ag Engineering Institute

THE Institute for Research in Agricultural Engineering established several years ago at the University of Oxford in England will, according to "The Implement and Machinery Review" of London, be taken over by the British Ministry of Agriculture and renamed the "Institute of Agricultural Engineering." In the new arrangement, general direction of the work will be under the auspices of the Agricultural Machinery Development Board. Apparently the testing of agricultural implements and machinery will continue to be one of the important activities of the Institute.

Personals of A.S.A.E. Members

W. H. Dickerson, Jr., assistant agricultural engineer, is one of the authors of Technical Bulletin 77, entitled "Surface Run-off and Erosion from Permanent Pastures in Southwest Virginia as Influenced by Applications of Triple Superphosphate," recently issued by the Virginia Agricultural Experiment Station. The report is on one phase of cooperative work which the Station and the agricultural division of the Tennessee Valley Authority have conducted.

O. E. Eggen, heretofore chief tractor engineer at the Hart-Parr Tractor Works of the Oliver Farm Equipment Co. at Charles City, Iowa, has recently been appointed plant manager of the tractor works.

Herman J. Finkel is at present employed as a junior engineer Great Lakes Division, U. S. Army Engineers, where he is doing flood control work. Prior to this he was employed as dairy farm inspector, division of health, City of St. Louis, Mo.

C. E. Frudden, executive engineer, tractor division, Allis-Chalmers Mfg. Co., who supervised the basic engineering and adaptation of rubber tires to farm tractors, is now serving as technical consultant for the farm machinery and equipment branch, Division of Industry Operations, War Production Board, Washington.

A. M. Goodman, agricultural engineer, Cornell University, is one of the authors of Bulletin 315, entitled "The Ventilation of Poultry Laying Houses," originally issued by that institution in 1935 and recently revised. The other author is the late F. L. Fairbanks, a former well-known agricultural engineer of Cornell University.

Russell E. Heston has resigned as assistant agricultural engineer of the Rural Electrification Administration (USDA) and is now employed as assistant automotive engineer, tank and combat vehicle division, office of the chief of ordnance, U. S. War Department.

B. A. Jennings and *P. R. Hoff,* members of the agricultural engineering staff, Cornell University, are joint authors of Bulletin 471, entitled "Repairing the Mowing Machine," recently issued by that institution.

Aldert Molenaar is now water planning analyst, water utilization planning service, Bureau of Agricultural Economics, USDA, and is located at Portland, Oregon. He was previously agricultural engineer with REA.

Ralph L. Ricketts has resigned as junior civil engineer of the U. S. Soil Conservation Service, to accept a position as extension agricultural engineer at the University of Missouri.

Norman C. Teter, formerly research fellow in agricultural engineering at the Iowa State College, has recently accepted a position as research worker in farm structures in the agricultural engineering department at North Carolina State College.

Francis D. Yung, research engineer in rural electrification, University of Nebraska, is author of agricultural-engineering progress report No. 9 (mimeographed), entitled "A Lamp Heated Electric Brooder," which deals with the heating of brooders with electric lamps to meet the shortage of metals commonly used in the manufacture of electric-heating elements.

A.S.A.E. Meetings Calendar

June 29 - July 1—Annual Meeting, Hotel Schroeder, Milwaukee.

November 30 - December 2—Fall Meeting, Stevens Hotel, Chicago

Applicants for Membership

The following is a list of recent applicants for membership in the American Society of Agricultural Engineers. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

Ralph J. Anderson, manager, farm department, The Sisalkraft Co., Chicago, Ill. (Mail) 2615 Greenleaf Ave.

George H. Breuning, associate civil engineer, Farm Security Administration, U. S. Department of Agriculture. (Mail) 630 E. 7th St., Durango, Colo.

Henry P. Clay, assistant professor, agricultural engineering department, Texas Technological College, Lubbock, Tex. (Mail) 2621 23rd St.

Lindley G. Cook, extension soil conservationist, New Jersey Agricultural Experiment Station, New Brunswick, N. J. (Mail) College Farm.

Philip V. Eshelman, assistant agricultural engineer, agricultural extension service, University of Nebraska, Lincoln, Nebr. (Mail) 4618 St. Paul.

Charles W. Geelan, junior agricultural engineer, Soil Conservation Service, U. S. Department of Agriculture. (Mail) Box 436, Snyder, Tex.

Jack A. Griffin, junior agricultural engineer, Soil Conservation Service, U. S. Department of Agriculture. (Mail) Box 484, Marfa, Tex.

Stanley E. Hill, engineer, in charge of field work, John Deere Harvester Wks., East Moline, Ill. (Mail) 2153 6th Street Court.

A. E. Johnson, farm service representative, new business department, Northern States Power Co., 2-4 South Barstow St., Eau Claire, Wis.

TRANSFER OF GRADE

Walter M. Carleton, instructor, agricultural engineering department, Kansas State College, Manhattan, Kans. (Mail) 1531 Leavenworth St. (Junior to Member)

Eugene D. Warner, extension architect, engineering extension, Kansas State College, Manhattan, Kans. (Mail) 1721 Pierre. (Junior to Member)

Machinery Shelters

THAT ARE EASY TO USE

Prolong the life, utility and earning power of valuable farm equipment

As a democracy girds for war, it calls for conservation of its fighting assets. Farm Implements are military machines today.

The critical metals shaped into tools for farm use may not be easy to replace — may soon become scarce.

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Shelters to protect these priceless fighting assets from the ravage of rain and sun, snow and sleet, assume new importance. You will be asked to design many such shelters.

The open, umbrella type shelter is regarded favorably by many designers for its ease of entrance and exit invites greater continuous use. It is easy to haul tractor or horse drawn tools into shelter at night. Easy to take them out the next day.

For either the open or closed type shelter, for garages and shops, there is available to your designing improved, ready-to-use 4-Square Lumber. You can design for greater economy with this modern lumber — and farmers can build better and more economically. 4-Square Lumber is properly seasoned and comes in a species and grade for every structural use. It is precision manufactured to exact lengths and sizes, with ends already squared. Specification of its exact lengths eliminates needless sawing, fitting and material waste. A catalog of 4-Square Lumber products will be mailed on request.

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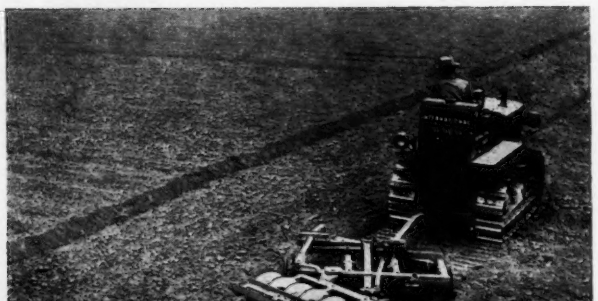

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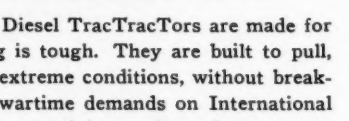

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By using Flexco HD Rip Plates, damaged conveyor belting can be returned to satisfactory service. The extra length gives a long grip on edges of rip or patch. Flexco Tools and Rip Plate Tool are used. For complete information ask for Bulletin F-100.

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Agricultural Engineering Digest

A review of current literature by R. W. TRULLINGER, assistant chief, Office of Experiment Stations, U. S. Department of Agriculture. Copies of publications reviewed may be procured only from the publishers at the addresses indicated.

FOUNDATIONS FOR FARM BUILDINGS, *T. A. H. Miller* and *E. G. Molander*. U. S. D. A. (Washington) Farmers' Bul. 1869 (1941). The authors point out that to design a good foundation, especially if soil conditions are unfavorable, requires considerable technical knowledge. Careful workmanship and good judgment in the application of simple but often-neglected principles will reduce the number of farm-building failures caused directly by faulty foundations, however. They discuss the selection of a suitable site on the basis of soil characteristics, test borings, and soil-bearing values; footings, including depth below grade, area of footings, thickness, and bonding; types of foundations (continuous walls, piers, precast concrete posts, concrete-slab floors, and timber foundations); cellar walls; construction of foundations; remodeling and repairs, including moving buildings among other operations; and designing foundations, including computation of dead and live loads.

ELECTRIC PIG AND LAMB BROODERS, *W. A. Junnila* and *H. G. McDonald*. Washington Agrl. Exp. Sta. (Pullman) Pop. Bul. 160 (1941), pp. 8, figs. 4. The pig brooder here described is built into the corner of the pen, having an inside height of 12 in, with front opening of 8 in, and is heated by a 150-w electric light bulb in a reflector fitted into an opening in the top of the brooder. It is noted that a 200-w bulb may be used in very cold weather, and that many users keep the brooder in operation for as much as two weeks for one litter, reducing the wattage to 100 after one week, and later, under favorable weather conditions, to 60 w.

The lamb brooder described is designed upon the same principle, but is shown as built against a side of the enclosure. It is described as 2 by 8 ft, 30 in high, and heated by 60-w bulbs placed 2 ft apart in a hemicylindrical tin-plate reflector. A smaller and portable brooder, for individual lambing pens, is also described.

(Continued on next page)

Student Branch News

PENNSYLVANIA

By James B. Kistler, Scribe

THE Pennsylvania Student Branch of A.S.A.E. at the Pennsylvania State College was privileged to have as its speaker on March 2nd, A. S. Marburger, one of the last year's graduates in ag engineering and a former president of the Branch. Mr. Marburger is now employed by the New Holland Machine Co., at New Holland, Pa. He gave an interesting account of his experiences with that company, and told of some of the practical problems with which he has been confronted.

At the next meeting, March 16, two of the present seniors in ag engineering addressed the student branch. Their topics had been prepared as projects for a senior course in "Agricultural Engineering Problems". K. H. Norris discussed the "Selection of Electric Motors for the Farm". He pointed out that in the present emergency electric motors can well be used on the farm to replace a hired man. In the selection of an electric motor for a particular job a great number of things must be taken into consideration. It is important to know the characteristics of each type of motor, the characteristics of the power supply, the torque requirements of the load, and the price limitations which must be met. Mr. Norris then went on to explain the characteristics of the split-phase, the capacitor, the repulsion-induction, and the series motors. He pointed out how one motor differed from another and gave examples of uses for each type of motor.

A. R. Hunsicker spoke on "Electric Soil Heating". He told of its use in hotbeds for raising plants out of season, and described in detail the history, applications, and installation of the soil heating units. Mr. Hunsicker pointed out that a constant temperature can be maintained by use of a thermostat, but that good insulation of the hotbeds against cold is necessary. He also cited the advantages, disadvantages, and relative cost of the electric method of heating hotbeds.

The business meeting of the evening consisted of committee reports, announcements, and the motion that the student branch should operate a booth at the Ag Frolic which is to be held April 18th in Recreation Hall.

MACHINERY FOR GROWING CORN, *C. K. Shedd, J. B. Davidson,* and *E. V. Collins.* (Coop. Iowa Exp. Sta.) U. S. Dept. Agr. (Washington) Cir. 592 (1940), pp. 30, figs. 15. To test the performance of the various machines available for use in corn production a study of corn-production machinery has been carried on at Ames, since 1931. The field experiments were located on the Iowa State College Agricultural Engineering Research Farm, a soil map of which is shown. The topography of this farm is relatively flat and the natural surface drainage inadequate. A system of tile drainage has been installed but during heavy rains some ponds form in the fields.

With respect to seedbed preparation it was shown that: Cornstalks were covered satisfactorily in plowing under some conditions without any preparation previous to plowing. Plowing was the only method of primary preparation of seedbed generally satisfactory, although cheaper methods of preparation were successful under some conditions. Better work was done by 16-in than by 14-in plows. Plow jointers improved coverage of crop residues and trash. Labor and power expenditures in plowing were about in proportion to depth of plowing. From plowing up to the time of planting, in the absence of quackgrass or other perennial weeds, the single-disk harrow produced as good results as did a field cultivator. A tandem-disk harrow was more effective than the single-disk harrow in filling up tractor wheel tracks and leveling off other irregularities. One tillage of plowed ground with tandem-disk harrow and spike-tooth harrow just before planting was generally sufficient seedbed preparation. Additional tillage did not improve weed control, stand, or yield of corn. A single tillage with a single-disk harrow or with a field cultivator proved insufficient preparation in one experiment. For lighter operations and final preparation of seedbed, the spike-tooth harrow was preferable to other machines except that a rotary hoe section was better adapted for use attached to the plow for spring plowing.

Concerning planting it was observed that: Comparing check-row and drill planting, the rate of work with four-row tractor planter was 4.5 acres per hour when checkrowing, or 7.5 acres per hour when drilling. Surface planting was generally found preferable to furrow planting, although there was no difference in yield. Row spacings of 42, 30, and 21 in were all found mechanically feasible.

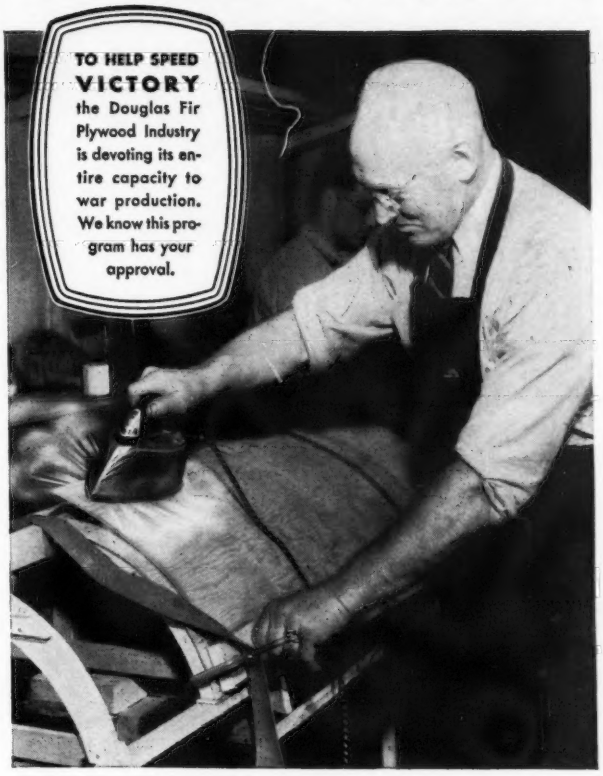
Of cultivation it is stated that: Early cultivation with spike-tooth harrow, spring-tooth weeder, or rotary hoe was effective in killing small weed seedlings when the soil had been lightly crusted by moderate rainfall. Labor and power requirements in using these machines were low. Early cultivation with a sweep cultivator after the corn had grown large enough for thorough weed coverage in the corn row destroyed practically all weeds. During six years, early cultivation was omitted without causing yield reduction, except in one year when wet weather prevented later cultivation at the proper time. Cultivator performance was improved by use of sweeps rather than shovels. Disk hillers were the most effective equipment for covering weeds in the corn row. An experimental spring-tooth weeder rear attachment for a tractor cultivator was effective in finishing the kill of weeds and leveling the soil between corn rows. By use of sweeps and disk hillers and the spring-tooth weeder rear attachment, good control of weeds in drill-planted corn was accomplished without excessive ridging of rows.

Of the lister-planter method it is noted that labor and power expenditures were lower, but yields were not so good as with the surface-planter method under central Iowa conditions.

AGRICULTURAL ENGINEERING INVESTIGATIONS (IOWA). (Partly coop. U.S.D.A.) Iowa Ag. Exp. Sta., Ames. Station Report (1940). These have included (part 1) an analysis of farm-building losses due to wind and fire, atmospheric exposure tests of wire and fencing, utilization of plywood, steel, and lumber in farm-building construction, and farm-fence construction, all by H. Giese; the agricultural engineering service, directed by J. B. Davidson; work on farm-building insulation, by H. J. Barre; a study of the efficiency and economy of pneumatic tires for transport wheels on agricultural equipment, by E. G. McKibben; and hill-culture studies with trees, shrubs, and ground-cover plants for conservation and erosion control, by J. M. Aikman. Part 2 notes trials of the efficiency of corn pickers, by C. K. Shedd, Davidson, and E. V. Collins; seedbed preparation for corn, and corn-production methods and equipment, both by Davidson, Collins, and Shedd; and methods, equipment, and buildings for storage and curing of corn, by Barre, Davidson, J. L. Robinson, and G. Semeniuk.

NON-PRESSURE PRESERVATIVE TREATMENT OF SOUTHERN PINE POSTS. South Carolina Ag. Exp. Sta., Clemson. Station report (1940). This is a discussion of work by G. H. Dunkelberg, G. B. Nutt, H. T. Polk, and A. R. Reed. *(Continued on page 142)*

Ever "ironed" any Plywood?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the Douglas Fir Plywood Industry is devoting its entire capacity to war production. We know this program has your approval.

Some day this unique method may help you solve a problem!

● At Oregon State College, Coach E. A. Stevens builds racing shells from 1/8-inch Exterior-type Douglas Fir Plywood. In order to shape the big, flat sheets into the required compound curves, he irons the plywood over the frame with an ordinary household steam iron. It takes but a few minutes to mold the plywood "skin" and have it ready for gluing and nailing to the frame. This method, Coach Stevens' own invention, enables him to build simpler, speedier, more durable shells at lower cost.

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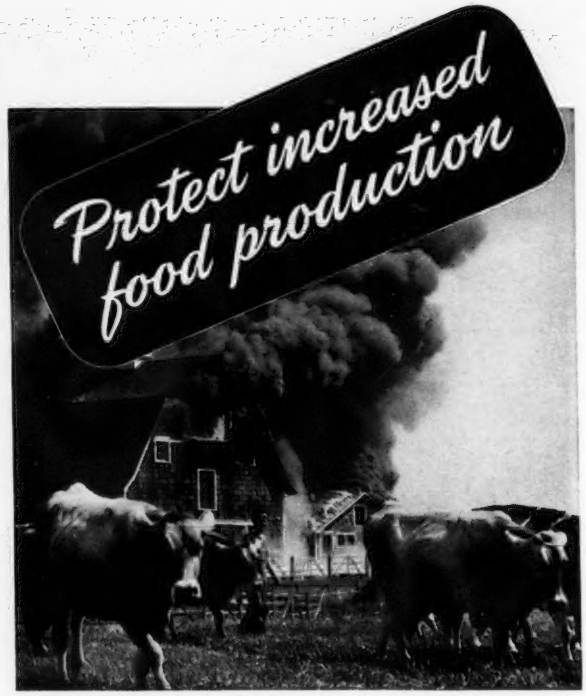

design farm buildings with

CONCRETE

Increased food output is a vital part of America's war program. A burned-out farm today, with its losses of stored foodstuffs, livestock and production facilities, is much more than a personal tragedy. The thousands of granaries, barns and other farm buildings destroyed each year represent a serious setback in the productive capacity of the nation.

The best line of defense is *firesafe design* with concrete. Sturdy concrete buildings minimize fire and storm losses. And their efficiency and sanitation are definite aids in stepping up the production of beef, pork, eggs, milk and other "war foods."

Concrete construction is all the more timely because it helps conserve critical materials. And it places a minimum burden on transportation, since aggregates are usually found locally.

Help the farmers who look to you for leadership. With moderate first cost, low upkeep and long life, concrete not only builds for immediate war production needs, but assures maximum farm efficiency for years to come.

Our agricultural engineers will gladly assist you on concrete design problems.

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BUY DEFENSE STAMPS AND BONDS...SUPPORT THE RED CROSS

Agricultural Engineering Digest

(Continued from page 141)

COSTS OF FARM POWER AND EQUIPMENT, *J. P. Hertel* and *P. Williamson*. New York (Cornell) Ag. Exp. Sta., Ithaca. Bul. 751 (1941). From the data obtained in a survey of 438 farms in 1936 and from complete cost-account records kept by 75 farmers for 1938 and 1939, it is shown that tractor power was more economical than horsepower for most farm work, and especially for such heavy draft jobs as plowing and fitting. On cost-account farms the cost of operating a tractor was about the same as that of a two-horse team. The cost per hour for horses and tractors depended largely on the annual use. The average cost per hour for a two-horse team and driver was 66c, compared with 80c for a tractor and driver. Farmers had about $1,500 invested per farm in power and equipment. The annual maintenance and operating cost was about $850. Depreciation and interest made up more than one-half the cost of operating equipment. Such costs as repairs, farm labor, housing, grease, oil, and fire insurance accounted for the remainder. More than one-half the depreciation occurred in the first 5 yr of use, but most tools were not discarded until they were from 15 to 20 yr old. The annual cost of equipment decreased as it became older, depreciation and interest dropping faster than the cost for repairs increased.

Almost one-half of the tools had been purchased second-hand. Second-hand equipment required a smaller investment and was cheaper to operate. From the standpoint of operating cost and reliability, the saving made by using second-hand equipment was greatest on farms where the equipment was needed for a relatively small number of acres or hours. Many farmers cooperated in the use of equipment and reduced their cost and investment by share owning, hiring, exchanging, and borrowing different tools. Except for borrowing, these arrangements were usually mutually beneficial, since the fixed costs could then be spread over more acres or hours of use.

With the exception of a few old tools, most equipment that might be badly damaged by exposure to the elements was housed. There was a tendency for tools that were not housed to be shorter lived and to have higher annual repair costs, but it seemed doubtful if a saving could be made by building a shed to house such tools, since the higher repair costs were offset by the saving in building costs.

DEVELOPMENT OF MACHINERY FOR HARVESTING AND STORING GRASS SILAGE, *H. E. Besley, C. Eby,* and *W. R. Humphries*. (Coop. U.S.D.A.) New Jersey Ag. Exp. Sta., New Brunswick. Bul. 689 (1941). This is a more or less popular account of time and labor-saving equipment and practices found practical in the mowing, raking, loading, cutting, and filling of the wide range of crops and crop combinations (legumes, cereals, and grasses) used in the preparation of "grass silage" in the northeastern states. The need for loaders, etc., of a construction stronger, because of the approximately three times greater weight of the material dealt with, than is necessary for handling cured hay is pointed out. Test runs on an experimental built-in conveyor for elevating field-chopped grass indicate significant economy of power and labor as compared with present practices.

New Literature

"DAIRY ENGINEERING," by Arthur W. Farrall (Member ASAE), senior research engineer, The Creamery Package Manufacturing Co.; formerly assistant professor in charge of dairy engineering, University of California. First edition. Cloth, 6x9 inches, 405 pages, 190 figures. $4.00. John Wiley & Sons, Inc., New York. This book is a complete modern treatise of dairy engineering, covering both principles and practice on all main types of dairy equipment. The author's aim has been to bring together data concerning the engineering phases of the dairy industry, in a simple and concise manner, so as to be understandable by the practical plant operator and also by the student of the dairy industry who has not had the benefit of technical engineering training. It is intended as a book that will assist in obtaining greater efficiency in dairy plant operation, as well as in the selection, installation, and management of dairy equipment. The treatment is from the standpoint of the operator and student rather than from that of the designer of dairy equipment. In the preparation of this text, the author has drawn largely from his many years of experience as an instructor in dairy engineering at the University of California, and his research work in dairy machinery with one of the largest dairy-equipment manufacturing companies in the country. Chapter headings include the following: Physical and Chemical Properties of Milk; Simple Mechanical Principles; Power Transmission; Electric Power and Equipment; Hydraulics and Pumping; Heat Measurement, Transfer and Control; Steam and Its Use in the Dairy; Principles *(Continued on page 144)*

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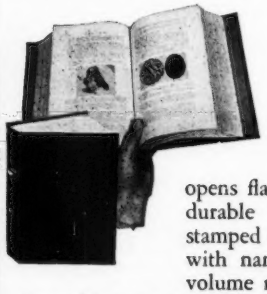

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New Literature

(Continued from page 142)

of Refrigeration; Insulation and Cold-Storage Rooms; Heaters—Coolers and Heat-Exchange Equipment; Ice Cream Freezing Equipment; Homogenizers; Pasteurizing Equipment; Evaporating and Drying Equipment; Can Washing and Sterilizing Equipment; Bottle Washers and Fillers; Cream and Butter Handling Equipment; Cheese and Casein Plant Equipment; Equipment Maintenance; Pipe, Pipe Fittings, Fitting and Soldering; Dairy Plant Design, Layout, and Utilization.

EMPLOYMENT BULLETIN

The American Society of Agricultural Engineers conducts an employment service especially for the benefit of its members. Only Society members in good standing may insert notices under "Positions Wanted," or apply for positions under "Positions Open." Both non-members and members seeking to fill positions, for which ASAE members are qualified, are privileged to insert notices under "Positions Open," and to be referred to members listed under "Positions Wanted." Any notice in this bulletin will be inserted once and will thereafter be discontinued, unless additional insertions are requested. There is no charge for notices published in this bulletin. Requests for insertions should be addressed to ASAE, St. Joseph, Michigan.

POSITIONS OPEN

SALES ENGINEER wanted. Excellent opportunity offered for young agricultural engineer with good background in farm building construction. Work involves direct sales of building material to dealers, architects, contractors. Earnings equivalent of salary of $3000.00 a year or more and unusual possibilities for advancement with rapidly expanding organization. Applicants should indicate marital status, number of dependents, selective service classification, earnings expected. PO-135

ENGINEERS needed by U. S. Government. The U. S. Civil Service Commission, Washington, D. C., has listed the following opportunities for engineering work for the federal government, of possible interest to A.S.A.E. members:

Technical Assistant (Engineering), $1,800 a year. Unassembled examination. Write for announcement No. 177.

Engineering Aide, photogrammetric and topographic options, $1440 to $2600 a year. Unassembled examination. Write for announcement No. 206.

Chemical Engineer (five grades), $2600 to $5600 a year. Unassembled examination. Write for announcement No. 163.

Copies of the announcements referred to may be obtained by writing direct to the Commission. They give full details concerning the positions, the requirements to be met, and where to obtain and file applications.

POSITIONS WANTED

AGRICULTURAL ENGINEER with B. S. degree in engineering and M. S. degree in agricultural engineering. Experienced in college teaching, experiment station, and extension work; also factory and construction work. Especially qualified for college agricultural engineering, manufacturing, defense, construction, or trade extension work. Age above draft. W-346

AGRICULTURAL ENGINEER with B.S. degree from midwestern college (1938) and M.S. degree from southern college (1940), desires employment with the Soil Conservation Service, in a defense industry, or in other engineering work. Has 1½ years' experience as engineer with the U. S. Soil Conservation Service in the South and in the Pacific Northwest. Familiar with agriculture in most parts of the United States. Civil Service rating as junior engineer. Eligible for reappointment. Age 35. Married. PW-345

AGRICULTURAL ENGINEER desires employment offering larger opportunity. Ten years' experience in the electric utility industry and two years' experience as an assistant extension agricultural engineer. Good farm background. Particularly qualified to handle all phases of rural electrification, pump irrigation, and farm machinery. Capable of planning and conducting educational or promotional activities. Holds a state professional engineering certificate. Thirty-six years of age. Married. References on request. PW-344

AGRICULTURAL ENGINEER with 15 years' experience in the farm equipment industry; knows both farmer and tractor and implement industry in all sections of world; especially Canada and U.S.; advertising, public relations, editorial, camera, radio; can direct a complete service for dealers and factory; knows governmental and agricultural college officials; Farm Bureau; boys' and girls' clubs, livestock and special crop associations. Will locate anywhere the right firm or industry may wish. Have production records that speak. Personal portfolio mailed on request. PW-343